Phase I Results
Regional Air Quality Modeling Study
Bonneville Power Administration

August 1, 2001

BPA has completed the first phase of a Regional Air Quality Modeling Study to examine potential air quality impacts from 45 natural gas-fired combustion turbines proposed for construction in BPA's service area. BPA has completed the first phase of the study on the 45 projects. Phase I examined two scenarios: a worst-case scenario in which all 45 plants were built and operated for a total of more than 24,000 megawatts (MW) and a second scenario in which 28 of the facilities, totaling a little over 11,000 MW operated simultaneously. However, it is highly unlikely that more than 6,000 to 8,000 MW will be built. Generally, the results were lower than expected. The study did not show any standards violations of criteria pollutants identified in the Clean Air Act. The only result that showed a possible need for concern was a potential decrease in visibility in many of the region's most sensitive areas.

Background. The West Coast has immediate supply needs for electricity, as well as a long-term need for electrical energy resources. Recent long-term planning estimates by the Pacific Northwest Electric Power and Conservation Planning Council show the region will need an additional 6,000 MW of electricity over the next 10 years. Other estimates run as high as 8,000 MW. This demand for electricity has led to a number of new generating resources being proposed to meet the regional energy need. More than 24,000 MWs of resources have been proposed. These proposals far exceed the need, which makes it difficult, if not impossible, to determine which resources will ultimately be constructed and operated.

BPA is being asked to integrate many of these resources into the Federal Columbia River Transmission System. Since the majority of these resources are combustion turbines, there is a regional concern over air quality. Thus, BPA initiated this Regional Air Quality Modeling Study to better understand, under worst-case conditions, the interaction of the site-specific effects. This information will help provide clarifying information for the cumulative environmental effects analysis conducted in BPA's Business Plan Environmental Impact Statement. BPA will commission its contractor to conduct a Phase II evaluation of each individual power plant's effects on visibility as it is considered and decided upon for integration by BPA.

Results from Phase I of the study are now available for review by interested parties. An overview of the modeling approach and presentation of the results follows.

Modeling Overview. The dispersion modeling techniques employed by the study are described in the *Modeling Protocol*.[1] Features of the model simulations include the following:

- The study looked at two scenarios; 1) air impact that would accrue if 28 of the projects were built and energized by 2004 and 2) air impacts that would occur if all 45 projects were built as planned and operated simultaneously.

[1] Available at http://www.efw.bpa.gov/cgi-bin/PSA/NEPA/SUMMARIES/air2.

- Oxides of nitrogen (NOx), particulate matter (PM10) and sulfur dioxide (SO2) emissions from 45 proposed power projects with a combined capacity of more than 24,000 MW were considered in the analysis. The analysis assumed all plants, including the peaking plants, were operating at peak load with their primary fuel for the entire simulation period. Emissions from fuel oil firing were not modeled except for the Fredonia (Washington) facility, which is solely fired by oil. Peak load operating assumptions are likely to over-estimate impacts, while omission of fuel oil firing likely under-estimates impacts.

- Building downwash effects were not considered in the analysis and emissions were characterized using a single stack for each facility. Note the simulations only include emissions from the turbines or heat recovery steam generators, not from ancillary sources (such as auxiliary boilers, gas heaters, and standby generators) associated with each project.

- The CALPUFF (Version 5.4 Level 000602_6) dispersion model was applied in the simulations. CALPUFF is the EPA's preferred model for long-range transport assessments. CALPUFF treats plumes as a series of puffs that move and disperse according to local conditions that vary in time and space. CALPUFF incorporates algorithms for wet and dry deposition processes, aerosol chemistry, and is accompanied by post-processors designed to assess regional haze.

- Winds were based on the University of Washington's simulations of Pacific Northwest Weather with the MM5 model from April 1, 1998, to March 15, 1999. The MM5 data set used in the simulations has a horizontal mesh size of 12 kilometers km) and over 30 vertical levels. Only one year of MM5-quality regional meteorological data is currently available. Phase I results are based on weather conditions during this year. Actual impacts may vary from year to year as weather patterns shift.

- The 696-km by 672-km study area includes all of Washington and portions of Oregon, Idaho, and British Columbia. Meteorological, terrain, and land use data were provided to the model using a horizontal grid of 12 kilometers (km). The terrain data are based on an average for each grid cell, so the simulations do not resolve potential local impacts in complex terrain. Maximum concentrations may be under-estimated because the 12-km grid cannot accommodate plume collision with local terrain. (Note: In each facility's air discharge permit, localized effects are evaluated individually, but not cumulatively.)

- A 6-km sampling grid was used, with one receptor in each grid. A 12-km grid was used for terrain and meteorological data.

- The study evaluated impacts to 16 Class I/Scenic/Wilderness Areas (3 National Parks, the Spokane Indian Reservation, and 12 Wilderness Areas), the Columbia River Gorge National Scenic Area (CRGNSA), and the Mt. Baker Wilderness.

- The aerosol concentrations used to characterize background extinction coefficients in the study represent excellent visual conditions. Background visibility parameters are presented in Table 4 of the Protocol. These parameters represent visibility on the best 5% of the days in the Class I/Scenic/Wilderness Areas and the best 20% of days in the CRGNSA and the Spokane Indian Reservation. Background ozone and ammonia concentrations, nitrogen deposition, and sulfur deposition data were also based on generally conservative assumptions and are presented in the protocol.

- Background concentrations of PM10, SO2, and NOx were not included in Phase I modeling. The Protocol stated that MFG (the company conducting the study) would "…add the modeled predictions to the existing concentrations and compare the results against NAAQS and Class I significance criteria…." MFG did not include background in Phase I because preliminary results indicated that power plant emissions contributed only minimally to ambient concentrations.

- PM10 concentrations include both primary and secondary aerosols and the nitrogen deposition estimates include the ammonium ion.

Phase I Results. Model results for pollutant concentrations, total nitrogen deposition, total sulfur deposition, and changes to background extinction are summarized in the attached tables for each Class I/Scenic/Wilderness Areas, CRGNSA, and the Mt. Baker Wilderness. Contour plots are also attached displaying model predictions over the entire study domain. The summary tables and plots are provided for two source groups: all projects and projects with an energization date before January 2004. Key results of Phase I include the following:

- **Areas showing greatest impact.** The contour plots suggest that if all the proposed plants are built, the greatest air quality impacts will occur in the Puget Sound Lowlands from Centralia to Bellingham, in the Hermiston area, and in the eastern portions of the Lower Columbia River Basin.

- **Class II Significant Impact Levels not exceeded (two exceptions).** With the exception of 2 receptors, predicted concentrations from the proposed power plants are less than the Significant Impact Levels (SILs)[2] for all pollutants and averaging periods. The peak PM10 concentration occurred near the Wallula Gap. The predicted PM10 concentration at this location was 4.54 micrograms per cubic meter (ug/m3), due to the operation of all of the plants scheduled to be energized prior to 2004. The peak PM10 concentration of all the proposed plants at this location was 12.4 ug/m3 (the 24 hour PM10 SIL is 5 ug/m3). The SILs were also exceeded in one other location; the 24 hour PM10 SIL was exceeded at a receptor located near the Tacoma tide flats, where the model predicts a 24

[2] It has been EPA's longstanding policy under the New Source Review and PSD programs to allow the use of Significant Impact Levels (SILs) to assess whether a proposed new or modified stationary source causes or contributes to a violation of the NAAQS or PSD Class II increments (40 CFR 51.165 (b)(2)). Sources with pollutant concentrations under the SILs are considered insignificant, whether or not background or other increment consuming sources affect the applicable pollutant concentration and averaging period of concern. Note that the use of the term "significant" impact level in the PSD program does not imply a "significant adverse impact" in a SEPA or NEPA sense, nor does it imply exceedances of ambient standards.

hour PM10 concentration of 6.2 ug/m3. The SILs are thresholds used in the evaluation of individual, not multiple facility impacts to the NAAQS.[3] If the combined impacts are below the individual plant thresholds (the SILs), their collective impact to NAAQS should be considered minimal and an in-depth analysis of these plants' impacts to NAAQS unnecessary. However the fact that SILs are exceeded does not necessarily mean that significant adverse impacts will result.

- **National Ambient Air Quality Standards not exceeded.** This study has not examined local impacts from the power projects[4], but model results suggest that even if all the proposed power plants were energized, they are unlikely to exceed the National Ambient Air Quality Standards (NAAQS). The peak ambient concentration occurred at a receptor near the Wallula gap (which is a non-attainment area for particulate matter). Predicted ambient concentrations at this location were only 8% of the NAAQS (PM10 24 hour NAAQS is 150 ug/m3). According to Washington State Department of Ecology estimates, proposed power plant emissions are small compared to emissions from existing sources. For example, NOx emissions from all of the proposed power plants comprise only 3.3% of Washington's total NOx emissions and only 11% of Washington's particulate emissions.

- **Proposed Class I SILs exceeded at several locations.** If all the plants scheduled to be energized before 2004 are built, their emissions are predicted to exceed the proposed 24 hour PM10 Class I SIL (0.3 ug/m3) in the CRGNSA and in the Spokane Indian Reservation. When all proposed sources were included in the model, the proposed 24 hour PM10 Class I SIL was exceeded in 11 out of 18 Class I/Scenic/Wilderness Areas. These exceedances suggest that if all the proposed plants were built, EPA might need to evaluate the effect of these plants on Class I/Scenic/Wilderness Areas in combination with existing sources, to evaluate increment consumption. However, BPA anticipates only a small portion of these plants will likely be built[5]. (Note: exceeding a SIL indicates that further evaluation is necessary, but it does not necessarily indicate that significant impacts have occurred.)

- **Relatively little Increment consumed.** Predicted concentrations of PM10, NOx, and SO2 from the proposed power projects are small fractions of the applicable Class I increments. For example, the peak PM10 concentration was only 1.54 ug/m3 in the Columbia River Gorge National Scenic Area (not a Class I/Scenic/Wilderness Area) which is well below the 24 hour PM10 Class I increment of 8 ug/m3. Based on EPA's Prevention of Significant Deterioration criteria, this implies that the power plants alone do not cause a significant deterioration of air quality as characterized by PM10, NOx, and SO2 concentrations.

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[3] Because there is no other available benchmark for evaluating impacts to NAAQS, this study conservatively compares multiple plant impacts to individual plant SILs.

[4] The 12km grid used in this study is too large to capture plume impaction with local terrain. Localized plant effects are captured in each facility's air permit.

[5] Power Planning Council estimates that the region will need approximately 6,000 MW by 2010 to meet load growth and reliability standards. The proposed projects total over 24,000 MW in capacity.

- **Nitrogen and Sulfur deposition below levels of concern.** Annual nitrogen and sulfur deposition predicted for the Class I/Scenic/Wilderness Areas, the CRGNSA, and the Mt. Baker Wilderness are less than one percent of the background deposition rates provided by the Federal Land Managers for these areas.

- **Visibility impacted.** The study results suggest the proposed power projects could have the potential to degrade visibility in the Class I areas, as characterized by guidance criteria established by the Federal Land Managers[6]. The model predictions indicate emissions from the plants scheduled to be energized prior to 2004 would degrade visibility on very clear days by more than 5% at 14 out of 18 Class I/Scenic/Wilderness Areas and by more than 10% at 8 areas. If all the proposed plants are built, visibility on very clear days has the potential to be frequently degraded by more than 10% at 12 out of 18 Class I/Scenic/Wilderness Areas and in the surrounding Class II areas. The sensitive areas most affected by the first group of plants (energized before 2004) are Mt. Rainier, the Alpine Lakes Wilderness, and the Mt. Baker Wilderness Area. The inclusion of all proposed plants (pre- and post-January 2004) results in more than 10% change in visibility in 12 out of 18 of the northwest's Class I/Scenic/Wilderness Areas. The model shows the Mt. Baker Wilderness Area, Alpine Lakes Wilderness Area, CRGNSA, Mt. Rainier National Park, and the Olympic National Park would be most affected.

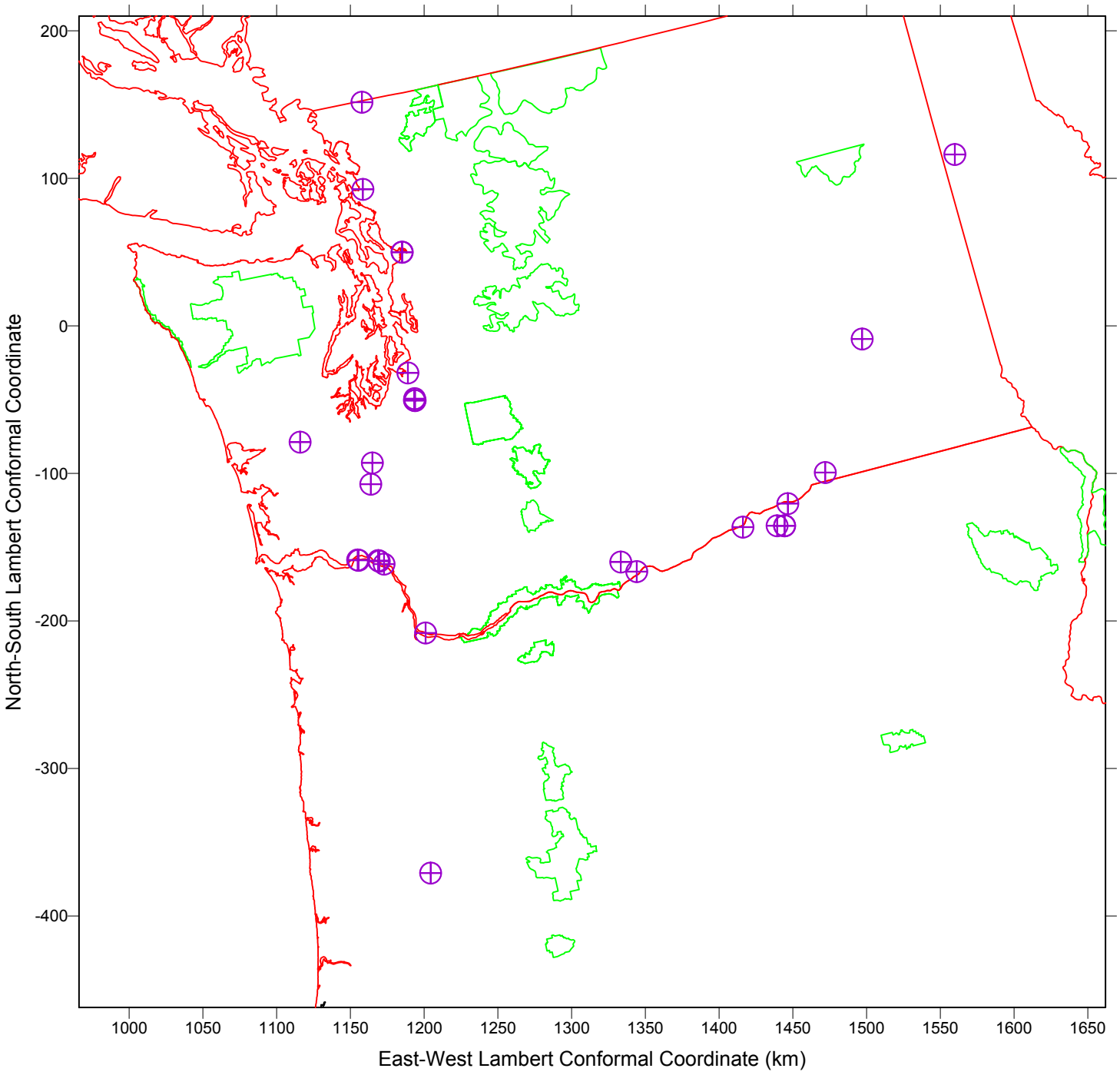
Phase II. Phase II will be implemented, as necessary, for power plants being considered for integration by BPA and evaluated through the NEPA process. Phase II will consist of a separate evaluation of each power plant's contribution to visibility impacts. This information will become part of the record and will be provided to the BPA decision-maker for use in making a decision on integration.

[6] "Federal Land Managers Air Quality Related Values Workgroup, Phase I Report, December, 2000".

Peak Emissions with Primary Fuel
Sources with Energization Dates Before January 2004

					Peak Emissions (lb/hr)		
Num	**Project Name**	**Owner**	**(MW)**	**Date**	**SO2**	**NOx**	**PM10**
1	TransAlta Centralia Generation LLC Big Hanaford Project	Transalta	248	Jun-01	6.6	21.1	16.2
2	Fredonia Facility	PSE	111	Jul-01	102.4	46.4	24.3
3	Rathdrum Power, LLC	Cogentrix	270	Aug-01	2.7	29.8	21.4
4	Vancouver a (Alcoa)	Calpine	100	Nov-01	0.7	16.0	5.0
5	Columbia Peaking Generation Project	Avista	200	Dec-01	2.8	13.6	11.2
6	Mcnary B	Calpine	200	Dec-01	1.3	32.0	10.0
7	Sumas Energy 2	NESCO	660	Jan-02	15.8	33.0	47.6
8	Goldendale (The Cliffs)	Summit	225	Feb-02	1.0	38.3	15.0
9	Columbia River Project	AES Columbia	220	May-02	7.3	25.3	17.2
10	Fredrickson	Calpine	350	May-02	1.5	17.1	18.0
11	Frederickson Power	West Coast	249	May-02	10.2	19.7	16.9
12	Coyote Springs 2	Avista	280	Jun-02	1.1	30.0	4.5
13	Port of Tacoma Generation Project Phase I Peaking Project	SW Power	175	Jun-02	2.6	61.0	18.0
14	Goldendale Energy Project	Calpine	248	Jul-02	1.0	14.9	11.8
15	Hermitston Power Project	Calpine	546	Sep-02	2.5	71.7	38.1
16	Everett Delta I	FPL	248	Sep-02	11.0	25.0	18.0
17	Everett Delta II	FPL	248	Sep-02	11.0	25.0	18.0
18	Pierce County Project	Duke	320	Jan-03	44.0	148.0	44.0
19	Satsop CT Project - Phase I	Duke	650	Jan-03	2.7	43.5	50.6
20	Mint Farm Generation Project I	Avista	248	Jul-03	2.7	25.0	18.8
21	Umatilla Tribal Generation Project	Confed.Tribes	1000	Jul-03	5.6	122.4	109.6
22	Longview Energy	Enron	290	Jul-03	1.4	25.0	19.9
23	Coburg Power	Frontier	600	Aug-03	1.5	54.7	15.8
24	Starbuck	NW Power Ent.	1200	Oct-03	17.7	106.4	82.8
25	Umatilla Generating Project	PG&E	620	Nov-03	9.8	40.4	48.0
26	Summit/Westward (Clatskanie)	Summit	520	Nov-03	8.0	54.0	48.0
27	Chehalis Generating Facility	Tractebel	520	Nov-03	20.8	40.9	31.6
28	Port Westward	PGE	650	Dec-03	12.7	43.8	26.8

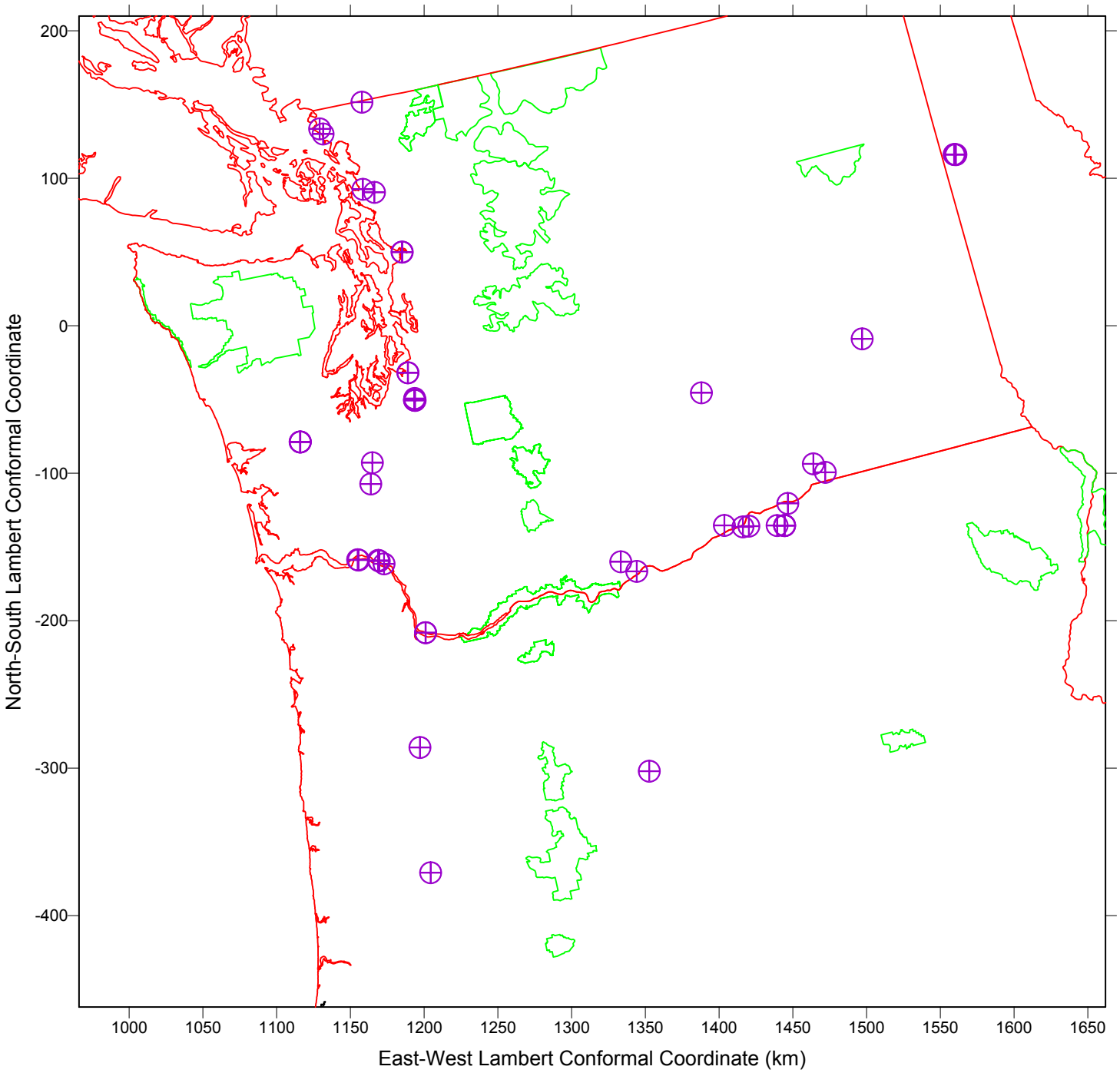
Source Locations for Sources with Energization Date Before 1/04



Peak Emissions with Primary Fuel
Sources with Energization Dates After December 2003

					Peak Emissions (lb/hr)		
Num	**Project Name**	**Owner**	**(MW)**	**Date**	**SO2**	**NOx**	**PM10**
1	Cherry Point	BP	750	Jan-04	3.0	45.1	35.7
2	Frederickson Power II	West Coast	249	Jan-04	10.2	13.6	15.6
3	Mcnary A	Calpine	600	Jun-04	3.0	34.2	36.0
4	Salem (Bethel PGE)	Calpine	600	Jun-04	3.0	34.2	36.0
5	Port of Tacoma Phase II (5 units)	SW Power	825	Jun-04	13.0	101.5	90.0
6	Grizzly Power	Cogentrix	980	Jul-04	52.8	114.4	105.6
7	Wallula Power Project	Newport Generation	1300	Jul-04	9.5	108.2	72.8
8	Mercer Ranch Generation Project	Cogentrix	800	Oct-04	42.7	92.4	85.3
9	Satsop CT Project - Phase II	Duke	650	Oct-04	2.7	43.5	50.6
10	Satsop CT Project - Phase III	Duke	650	Oct-04	2.7	43.5	50.6
11	Northern Idaho Power	Cogentrix	810	Dec-04	34.5	83.5	70.5
12	Morrow Generating Project	PG&E	620	Jan-05	9.8	40.4	48.0
13	Ferndale	Calpine	600	Jun-05	3.0	34.2	36.0
14	Mount Vernon	Calpine	600	Jun-05	3.0	34.2	36.0
15	Vancouver b (Alcoa)	Calpine	600	Jun-05	3.0	34.2	36.0
16	Mattawa (Grant Co)	Grant Co. LLC	1300	Jun-05	9.5	108.2	72.8
17	Kootenai Power (Rathdrum)	Kootenai Generation	1300	Jun-05	4.4	87.6	94.4

Source Locations for All Sources



Maximum Concentration Predictions (ug/m3)
Includes Sources with Energization Dates Before Jan 2004

	Annual Average			24-hour		3-hour
Area	**NOx**	**PM10**	**SO2**	**PM10**	**SO2**	**SO2**
Diamond Peak Wilderness	0.001	0.005	0.000	0.07	0.01	0.01
Three Sisters Wilderness	0.004	0.010	0.001	0.11	0.01	0.03
Mt. Jefferson Wildnerness	0.003	0.013	0.001	0.15	0.01	0.03
Strawberry Mtn. Wilderness	0.001	0.008	0.001	0.14	0.01	0.02
Mt. Hood Wilderness	0.009	0.027	0.003	0.28	0.02	0.05
CRGNSA	0.032	0.055	0.007	0.62	0.05	0.16
Eagle Cap Wilderness	0.004	0.014	0.001	0.12	0.01	0.03
Hells Canyon Wilderness	0.004	0.012	0.001	0.10	0.01	0.02
Mt. Adams Wilderness	0.007	0.020	0.003	0.19	0.03	0.05
Goat Rocks Wilderness	0.008	0.020	0.003	0.13	0.03	0.08
Mt. Rainier National Park	0.017	0.034	0.008	0.29	0.05	0.20
Olympic National Park	0.009	0.017	0.003	0.20	0.10	0.22
Alpine Lakes Wilderness	0.028	0.045	0.013	0.29	0.10	0.26
Glacier Peak Wilderness	0.014	0.026	0.011	0.17	0.13	0.61
North Cascades National Park	0.013	0.024	0.015	0.17	0.19	0.61
Pasayten Wilderness	0.006	0.011	0.005	0.06	0.06	0.21
Mt. Baker Wilderness	0.025	0.042	0.029	0.25	0.26	1.41
Spokane Indian Res.	0.010	0.025	0.003	0.46	0.04	0.11
EPA Proposed Class I SIL	0.100	0.200	0.100	0.30	0.20	1.00

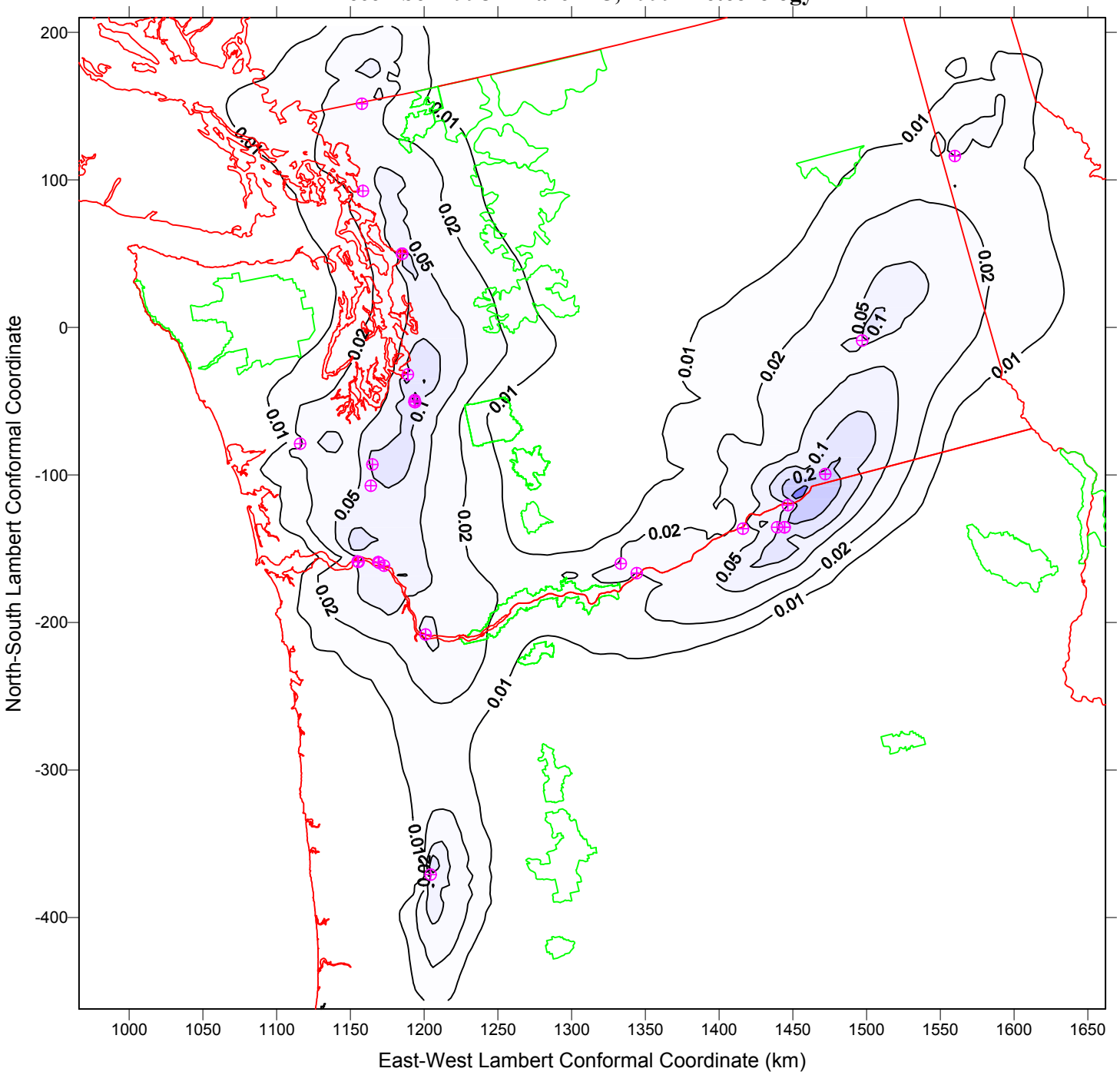
Note: PM10 includes sulfates and nitrates.

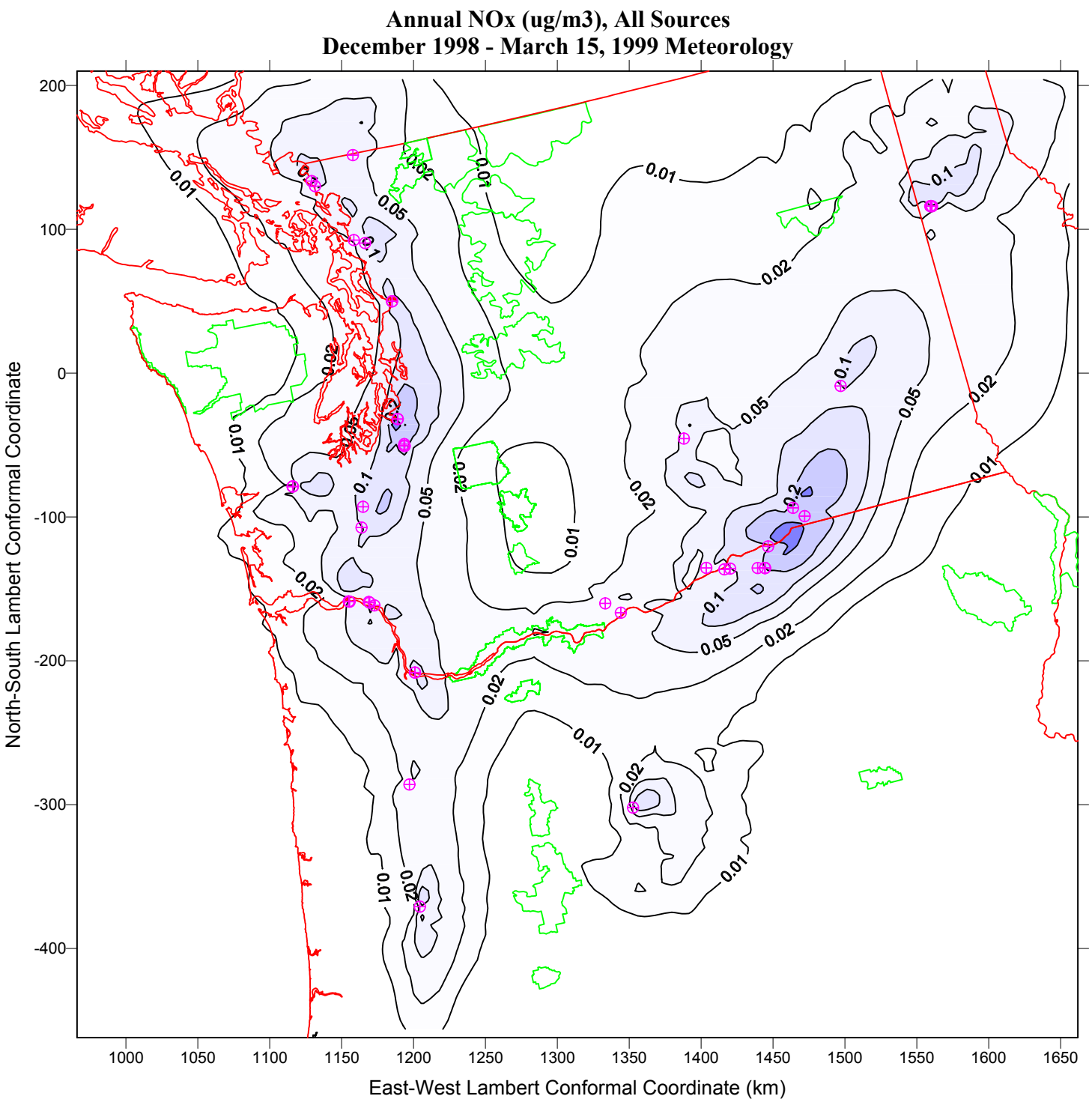
Maximum Concentration Predictions (ug/m3)
Includes All Sources

	Annual Average			24-hour		3-hour
Area	**NOx**	**PM10**	**SO2**	**PM10**	**SO2**	**SO2**
Diamond Peak Wilderness	0.003	0.014	0.002	0.15	0.02	0.06
Three Sisters Wilderness	0.007	0.025	0.004	0.31	0.08	0.21
Mt. Jefferson Wildnerness	0.007	0.031	0.004	0.37	0.08	0.25
Strawberry Mtn. Wilderness	0.003	0.019	0.002	0.18	0.02	0.12
Mt. Hood Wilderness	0.014	0.051	0.005	0.71	0.07	0.12
CRGNSA	0.047	0.094	0.010	1.54	0.18	0.33
Eagle Cap Wilderness	0.007	0.028	0.003	0.24	0.02	0.08
Hells Canyon Wilderness	0.006	0.022	0.002	0.18	0.01	0.04
Mt. Adams Wilderness	0.010	0.036	0.004	0.41	0.03	0.17
Goat Rocks Wilderness	0.010	0.034	0.004	0.24	0.03	0.11
Mt. Rainier National Park	0.022	0.055	0.010	0.52	0.08	0.35
Olympic National Park	0.019	0.035	0.003	0.43	0.10	0.23
Alpine Lakes Wilderness	0.040	0.077	0.016	0.49	0.11	0.31
Glacier Peak Wilderness	0.020	0.047	0.012	0.28	0.14	0.63
North Cascades National Park	0.022	0.043	0.016	0.32	0.19	0.63
Pasayten Wilderness	0.009	0.020	0.005	0.11	0.06	0.22
Mt. Baker Wilderness	0.041	0.075	0.031	0.38	0.27	1.42
Spokane Indian Res.	0.021	0.055	0.006	0.66	0.07	0.32
EPA Proposed Class I SIL	0.100	0.200	0.100	0.30	0.20	1.00

Note: PM10 includes sulfates and nitrates.

Annual NOx (ug/m3), Sources with Energization Date Before 1/04
December 1998 - March 15, 1999 Meteorology




Annual NOx (ug/m3), All Sources
December 1998 - March 15, 1999 Meteorology
North-South Lambert Conformal Coordinate
East-West Lambert Conformal Coordinate (km)
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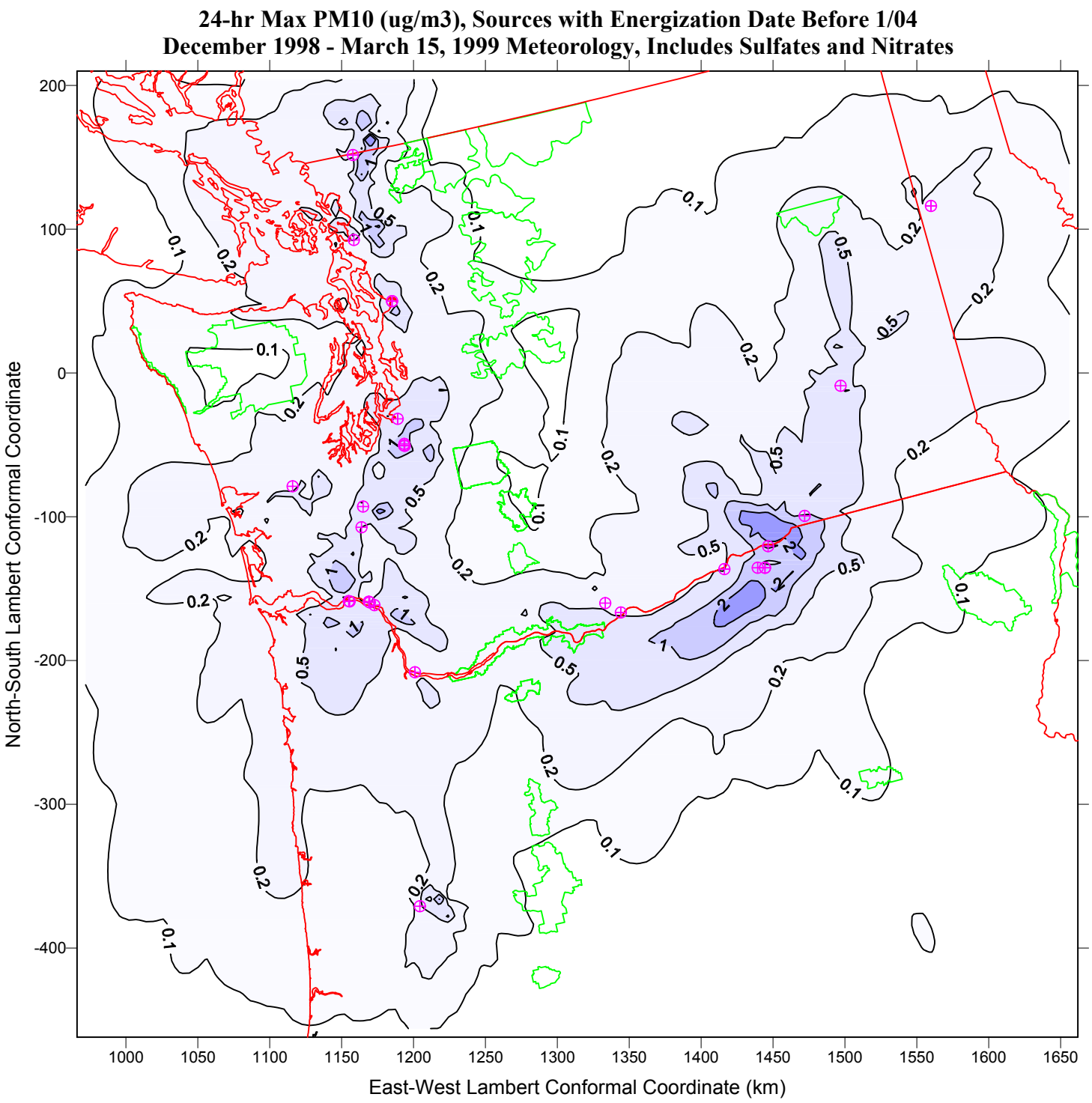
24-hr Max PM10 (ug/m3), Sources with Energization Date Before 1/04
December 1998 - March 15, 1999 Meteorology, Includes Sulfates and Nitrates
North-South Lambert Conformal Coordinate
East-West Lambert Conformal Coordinate (km)
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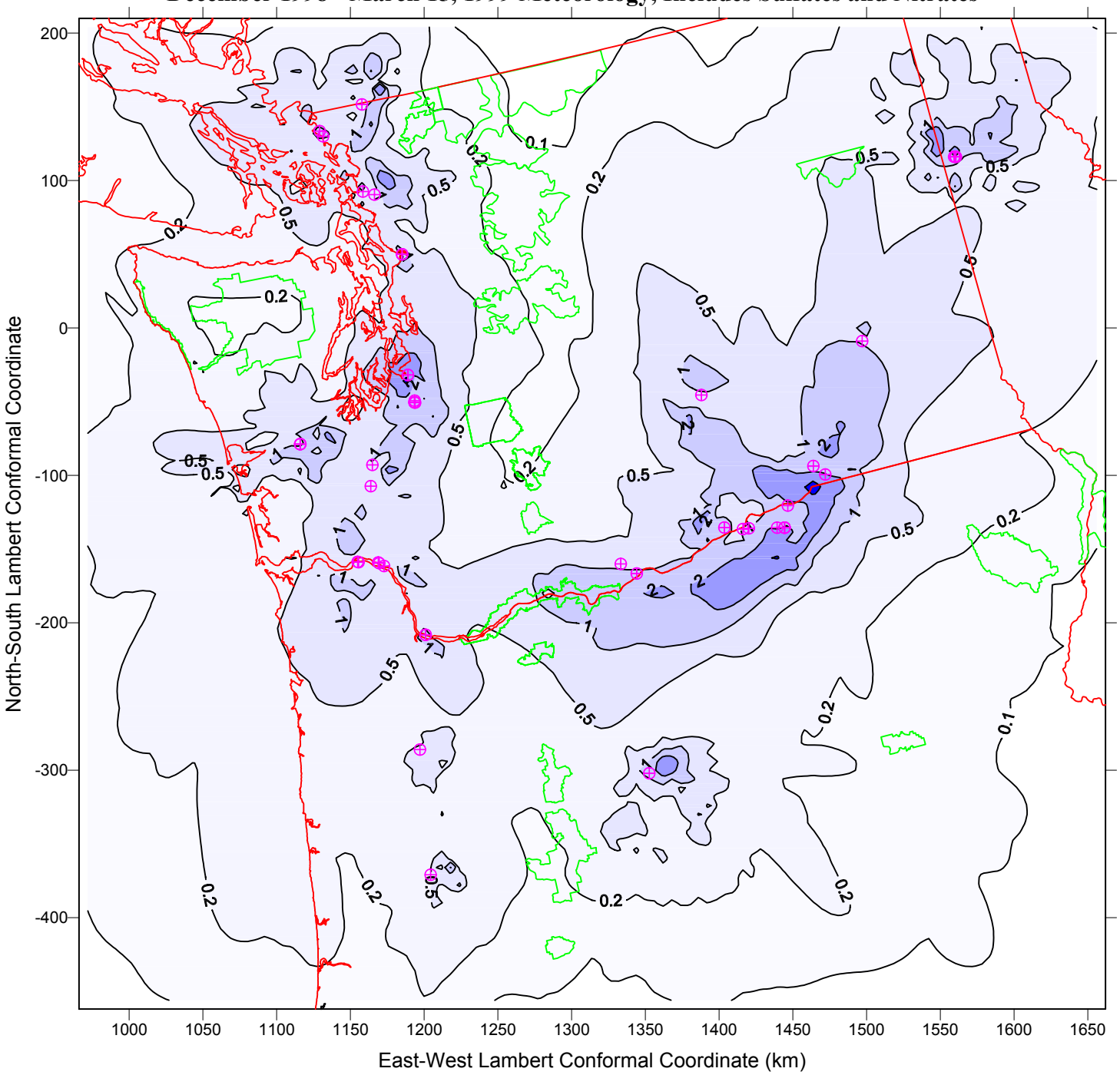
24-hr Max PM10 (ug/m3), All Sources
December 1998 - March 15, 1999 Meteorology, Includes Sulfates and Nitrates
North-South Lambert Conformal Coordinate
East-West Lambert Conformal Coordinate (km)
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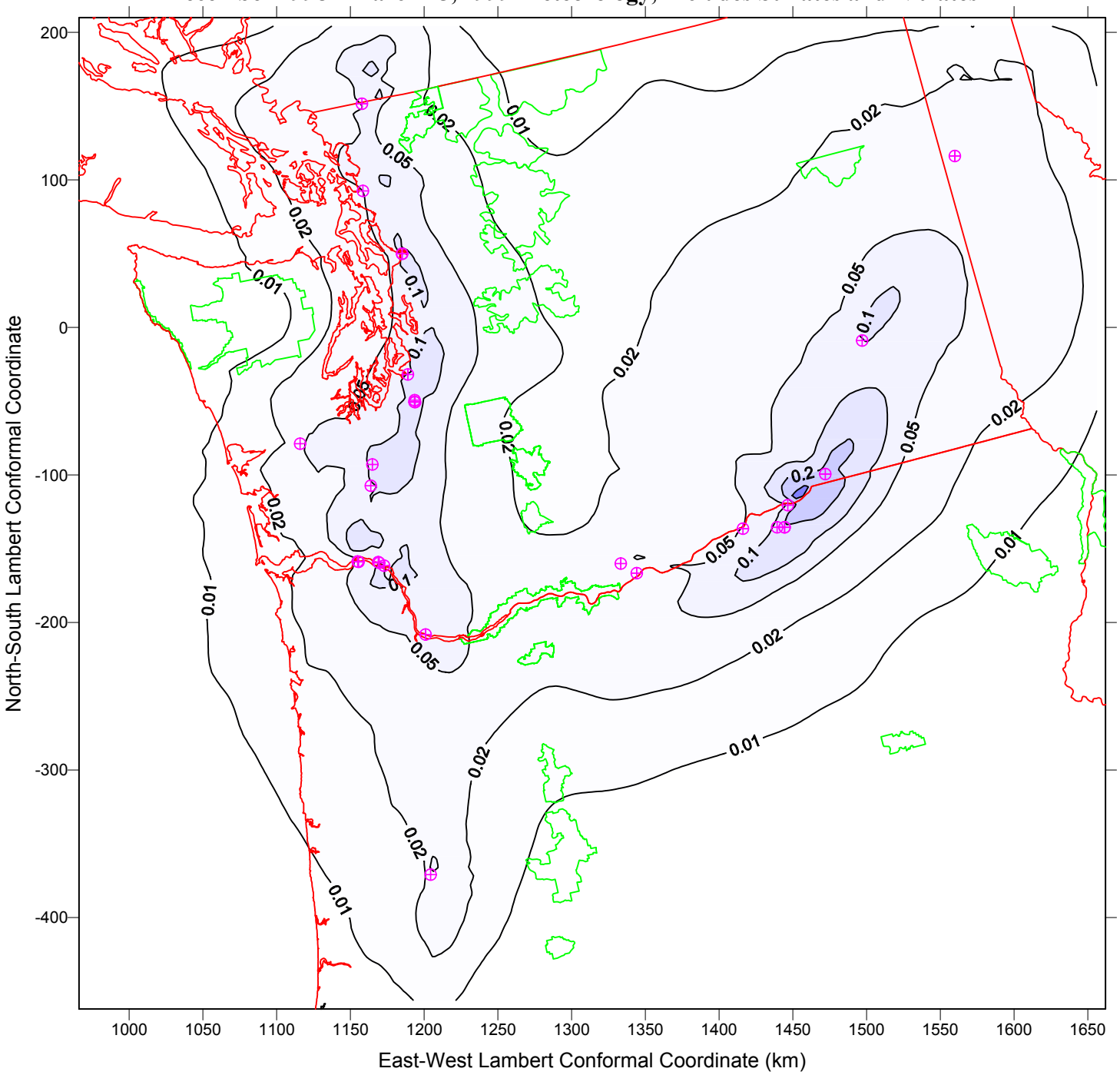
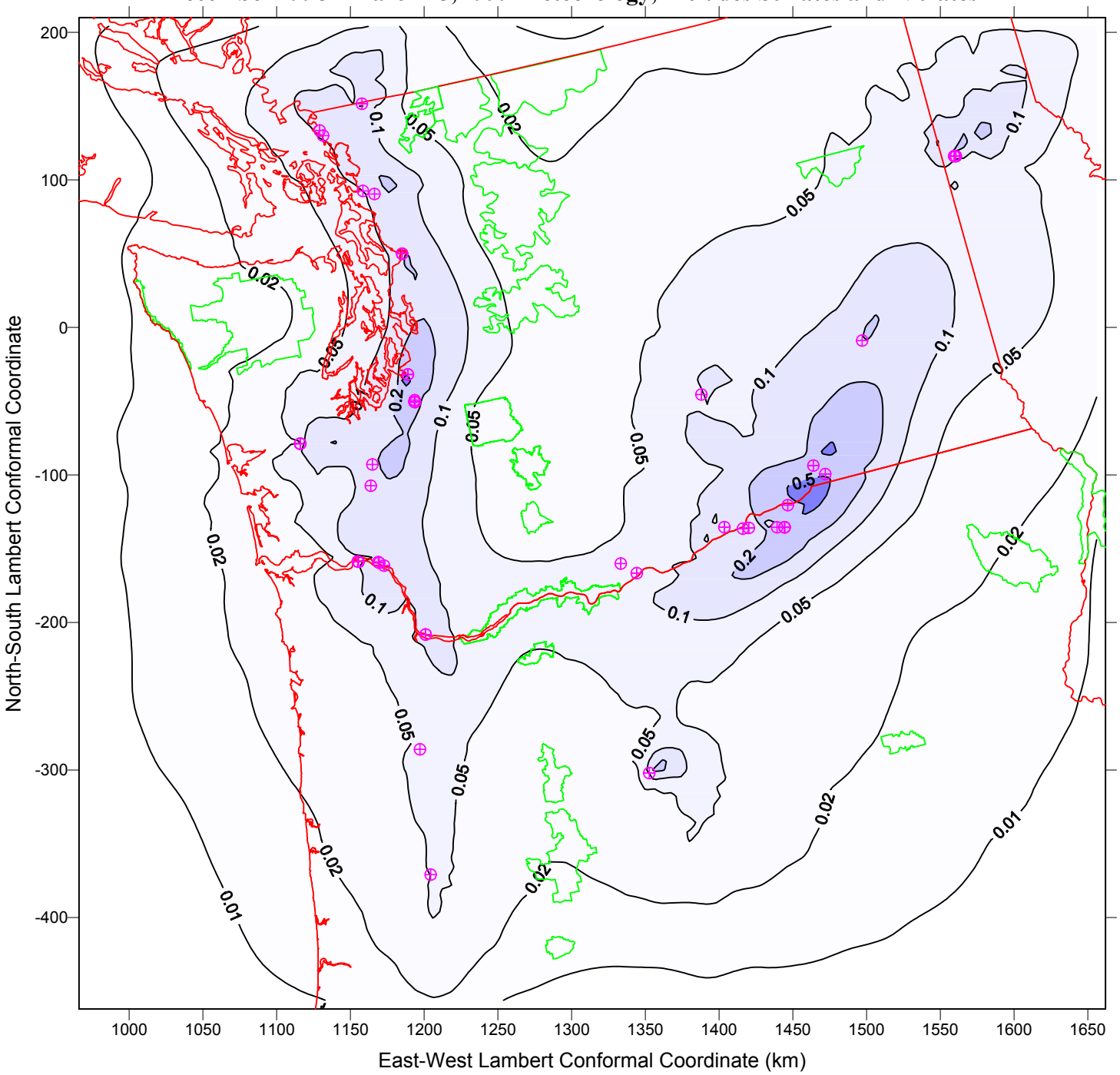
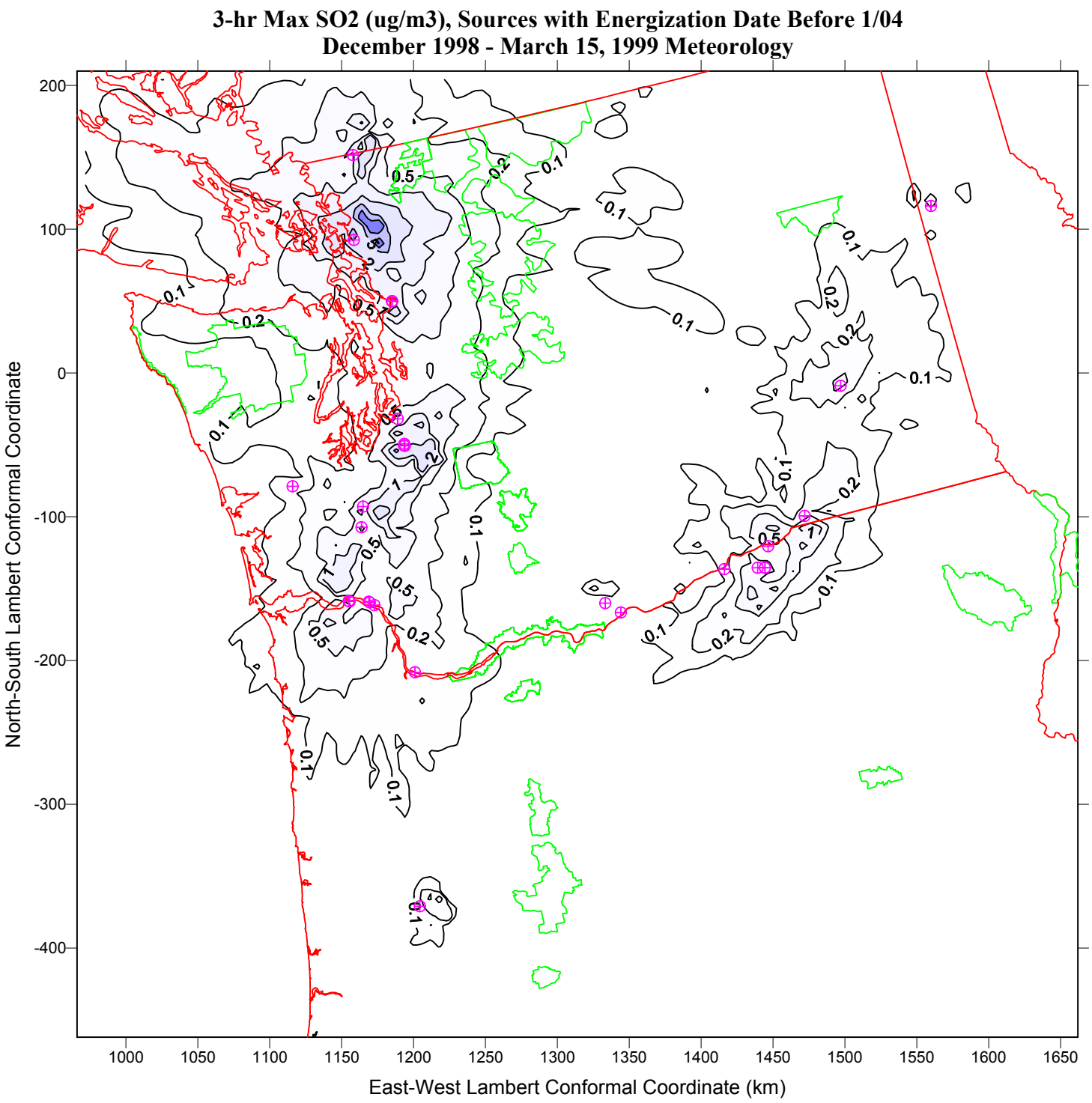
Annual PM10 (ug/m3), Sources with Energization Date Before 1/04
December 1998 - March 15, 1999 Meteorology, Includes Sulfates and Nitrates



Annual PM10 (ug/m3), All Sources
December 1998 - March 15, 1999 Meteorology, Includes Sulfates and Nitrates




3-hr Max SO2 (ug/m3), Sources with Energization Date Before 1/04
December 1998 - March 15, 1999 Meteorology
North-South Lambert Conformal Coordinate
East-West Lambert Conformal Coordinate (km)
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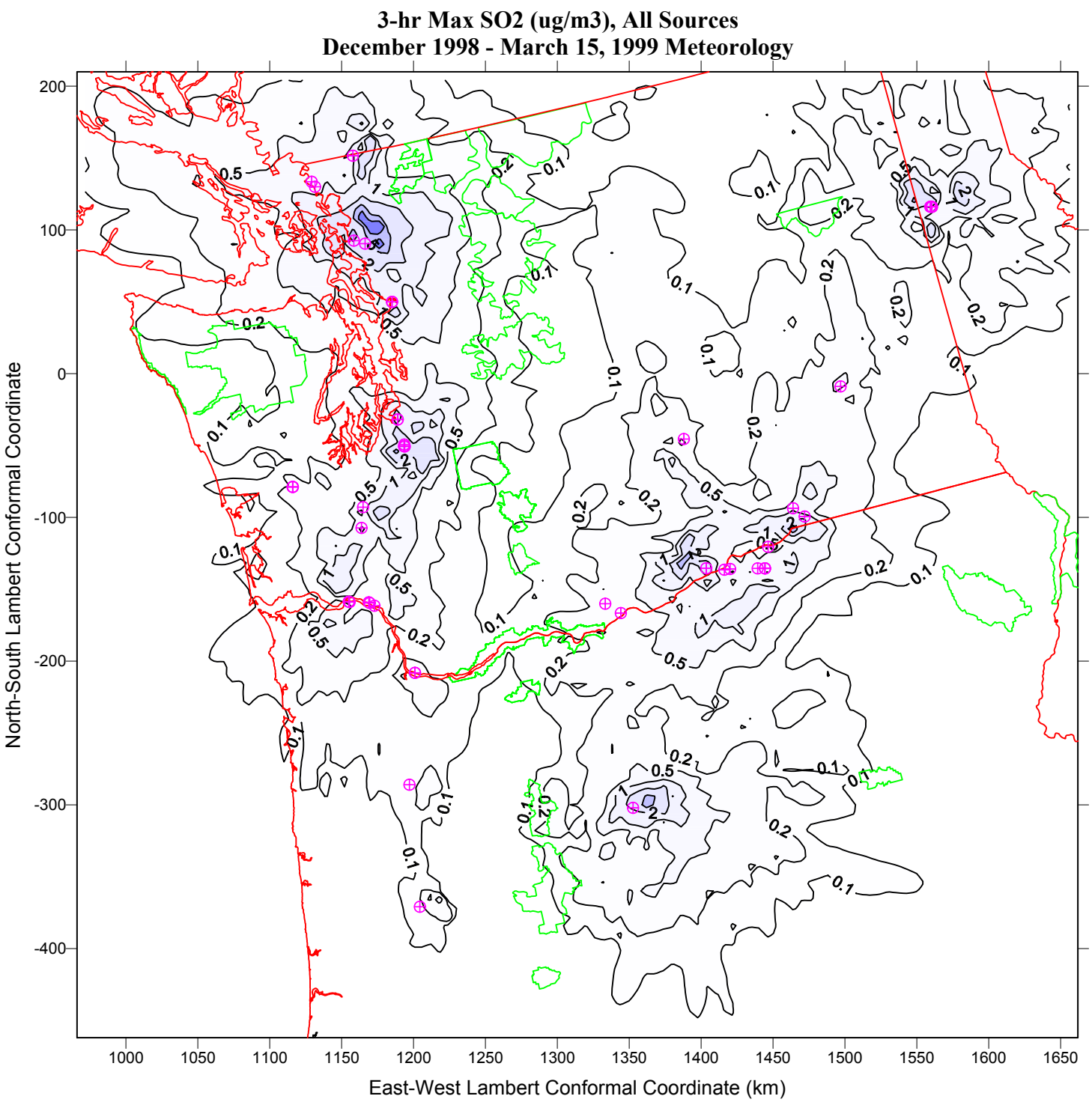
3-hr Max SO2 (ug/m3), All Sources
December 1998 - March 15, 1999 Meteorology
North-South Lambert Conformal Coordinate
East-West Lambert Conformal Coordinate (km)
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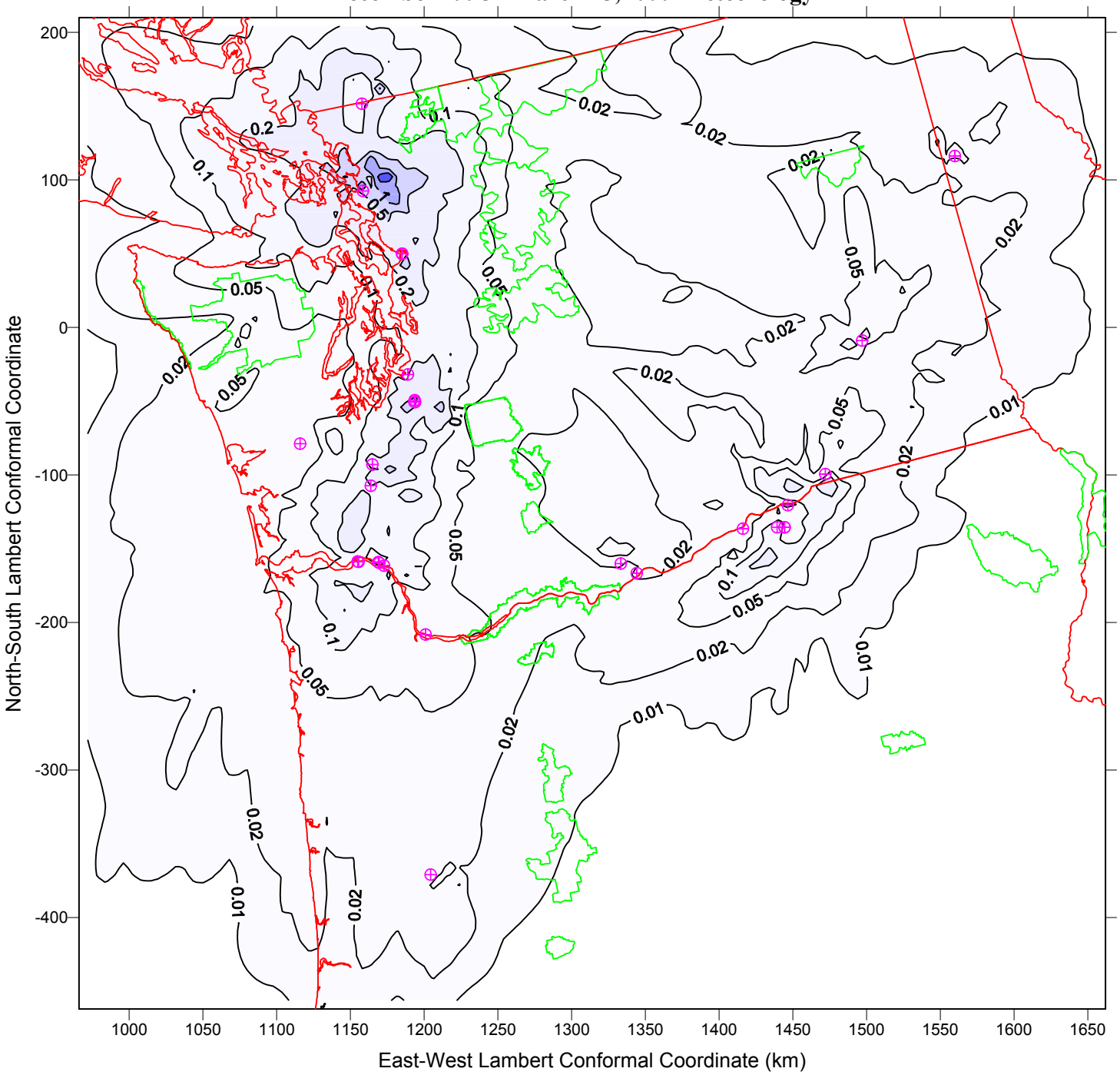
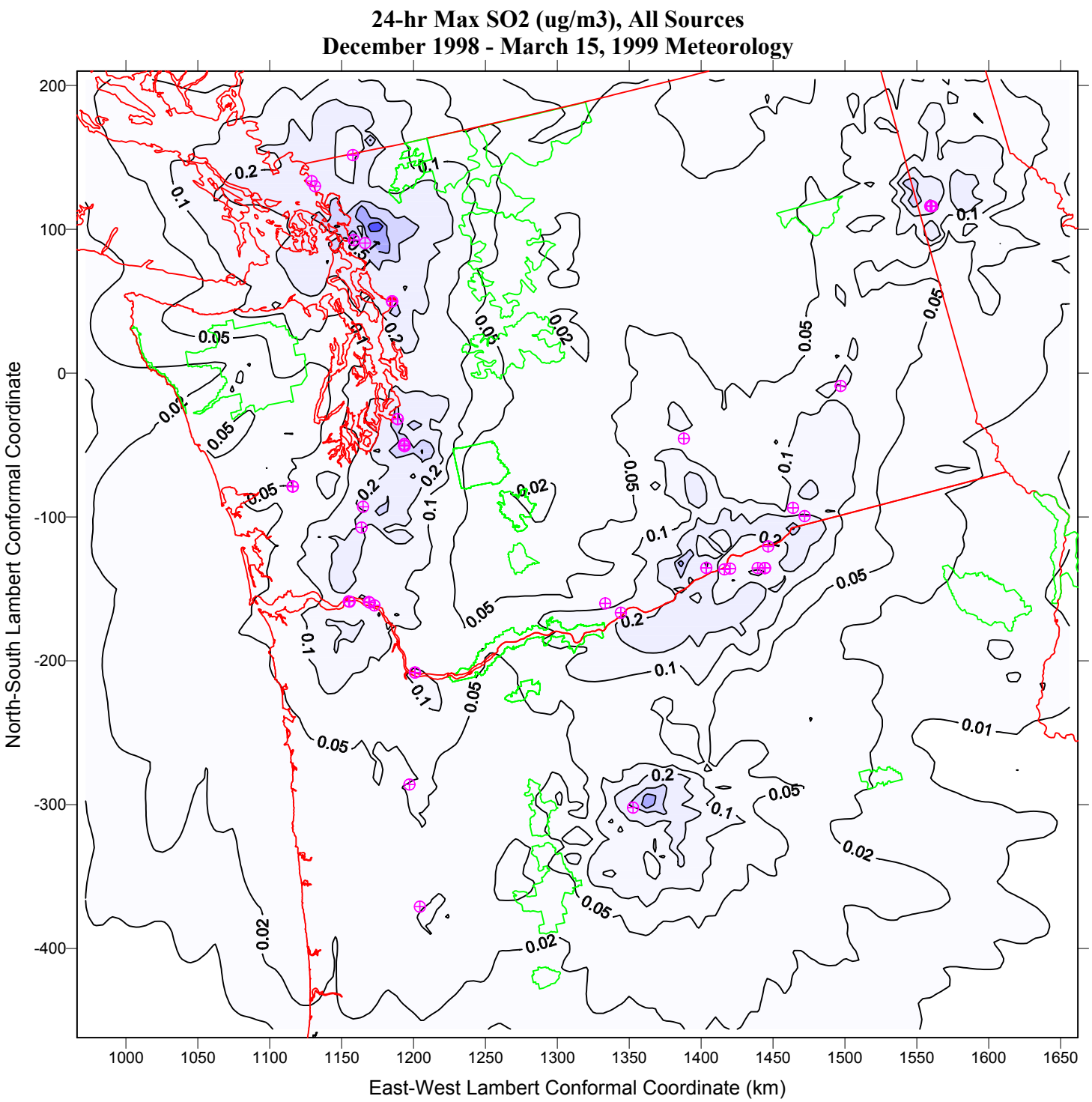
24-hr Max SO2 (ug/m3), Sources with Energization Date Before 1/04
December 1998 - March 15, 1999 Meteorology




24-hr Max SO2 (ug/m3), All Sources
December 1998 - March 15, 1999 Meteorology
North-South Lambert Conformal Coordinate
East-West Lambert Conformal Coordinate (km)
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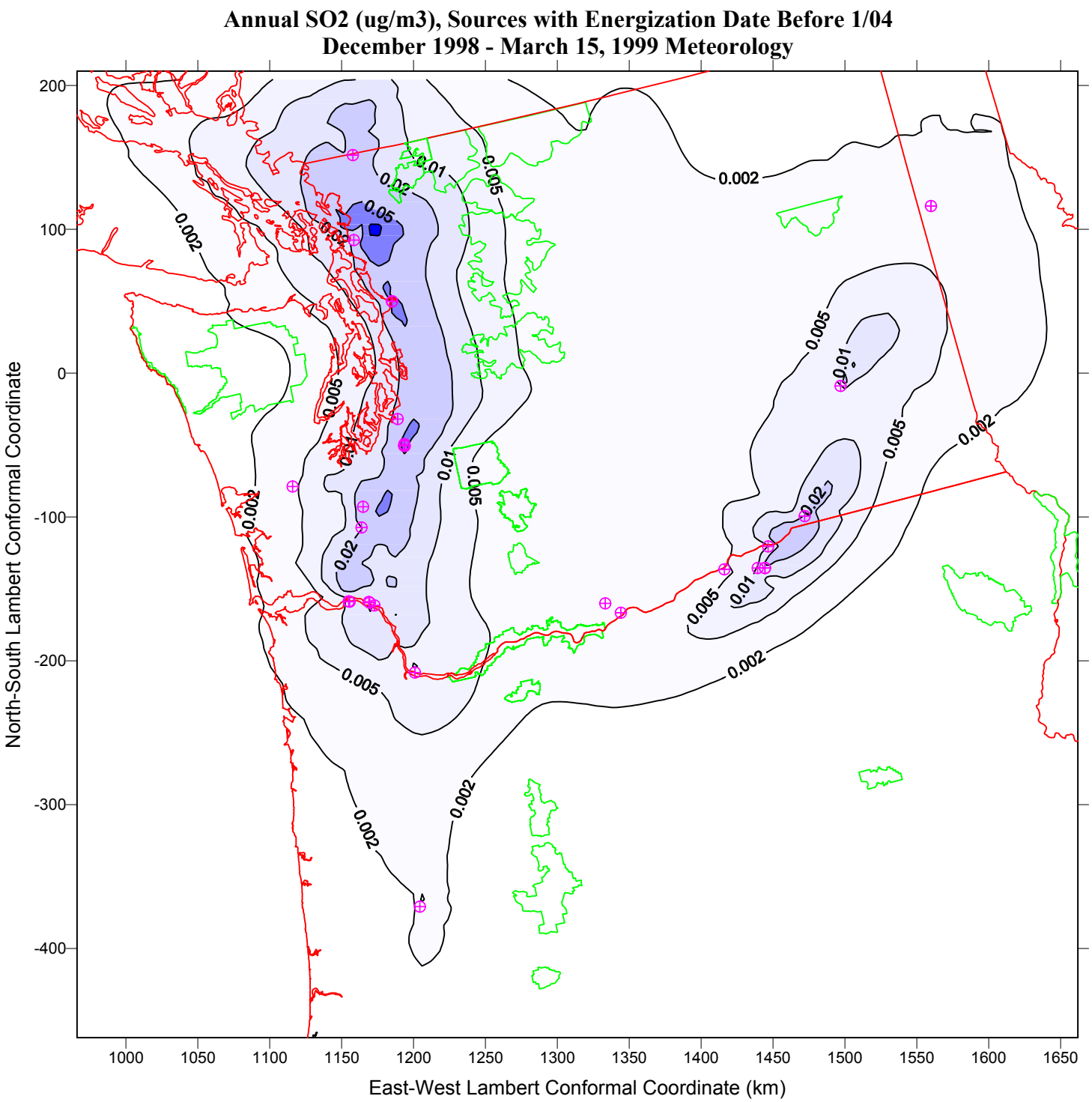
Annual SO2 (ug/m3), Sources with Energization Date Before 1/04
December 1998 - March 15, 1999 Meteorology
North-South Lambert Conformal Coordinate
East-West Lambert Conformal Coordinate (km)
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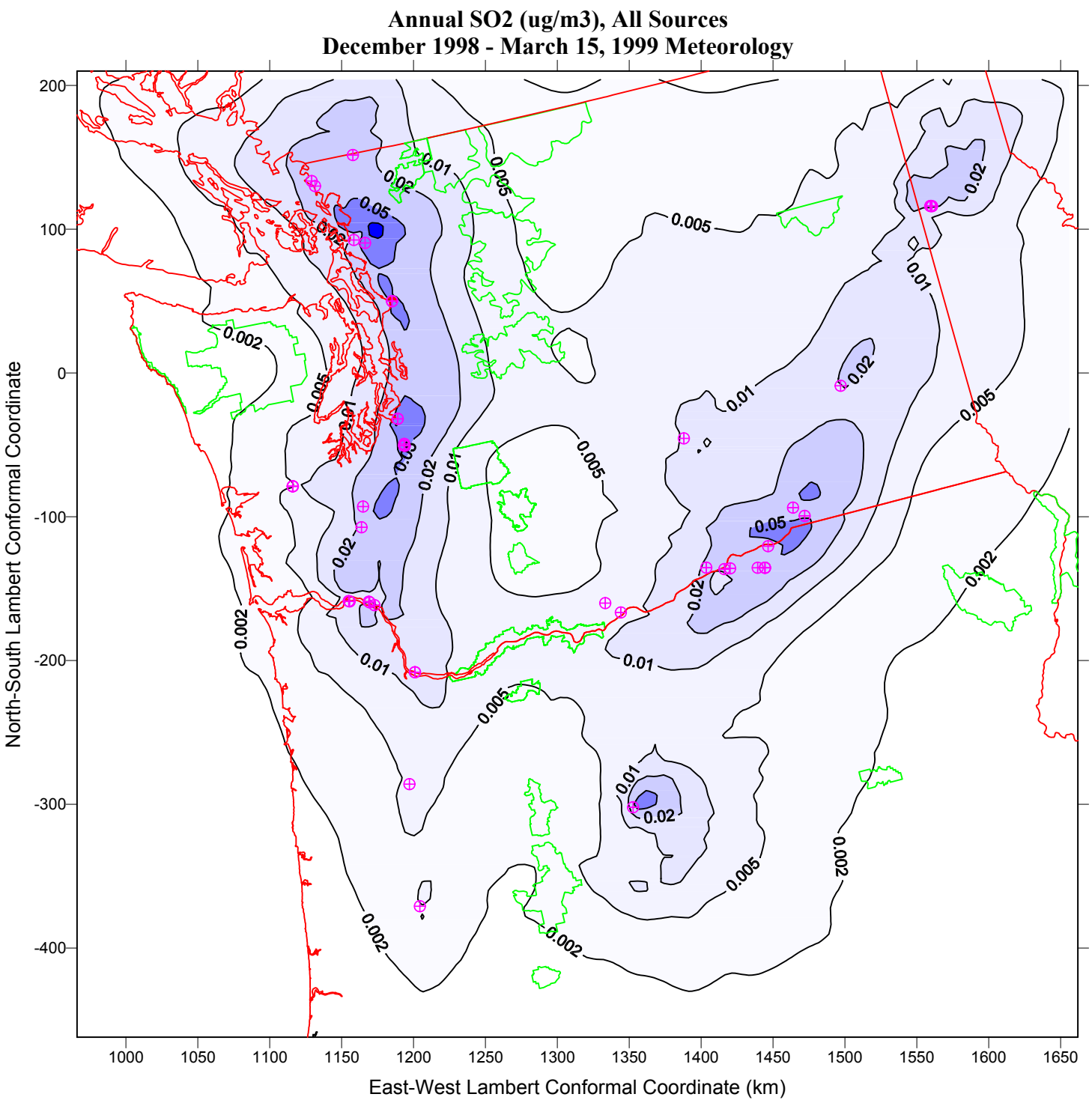
Annual SO2 (ug/m3), All Sources
December 1998 - March 15, 1999 Meteorology
North-South Lambert Conformal Coordinate
East-West Lambert Conformal Coordinate (km)
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Maximum Annual Deposition (Wet + Dry) Flux
Includes Sources with Energization Dates Before Jan 2004

Area	Annual Sulfur Deposition (kg/ha/yr)				Annual Nitrogen Deposition (kg/ha/yr)			
	Background	Sources	Total	Change (%)	Background	Sources	Total	Change (%)
Diamond Peak Wilderness	4.000	0.001	4.001	0.027%	2.200	0.003	2.203	0.126%
Three Sisters Wilderness	5.600	0.002	5.602	0.040%	3.600	0.007	3.607	0.185%
Mt. Jefferson Wildnerness	4.000	0.002	4.002	0.057%	1.800	0.006	1.806	0.345%
Strawberry Mtn. Wilderness	1.400	0.001	1.401	0.073%	1.200	0.002	1.202	0.192%
Mt. Hood Wilderness	8.600	0.003	8.603	0.039%	5.400	0.008	5.408	0.148%
CRGNSA	12.000	0.006	12.006	0.048%	10.000	0.013	10.013	0.133%
Eagle Cap Wilderness	1.600	0.002	1.602	0.108%	1.600	0.005	1.605	0.327%
Hells Canyon Wilderness	1.400	0.002	1.402	0.123%	1.200	0.005	1.205	0.448%
Mt. Adams Wilderness	10.800	0.004	10.804	0.036%	9.000	0.007	9.007	0.079%
Goat Rocks Wilderness	11.800	0.004	11.804	0.038%	9.000	0.007	9.007	0.077%
Mt. Rainier National Park	3.100	0.009	3.109	0.294%	2.400	0.012	2.412	0.511%
Olympic National Park	5.600	0.004	5.604	0.078%	2.000	0.008	2.008	0.396%
Alpine Lakes Wilderness	7.200	0.019	7.219	0.261%	5.200	0.024	5.224	0.452%
Glacier Peak Wilderness	8.000	0.017	8.017	0.216%	5.800	0.015	5.815	0.261%
North Cascades National Park	3.500	0.026	3.526	0.730%	5.200	0.017	5.217	0.329%
Pasayten Wilderness	7.200	0.009	7.209	0.126%	5.200	0.007	5.207	0.142%
Mt. Baker Wilderness	No Data	0.048			No Data	0.027		
Spokane Indian Res.	No Data	0.003			No Data	0.009		
USFS Criteria			3.000				5.000	

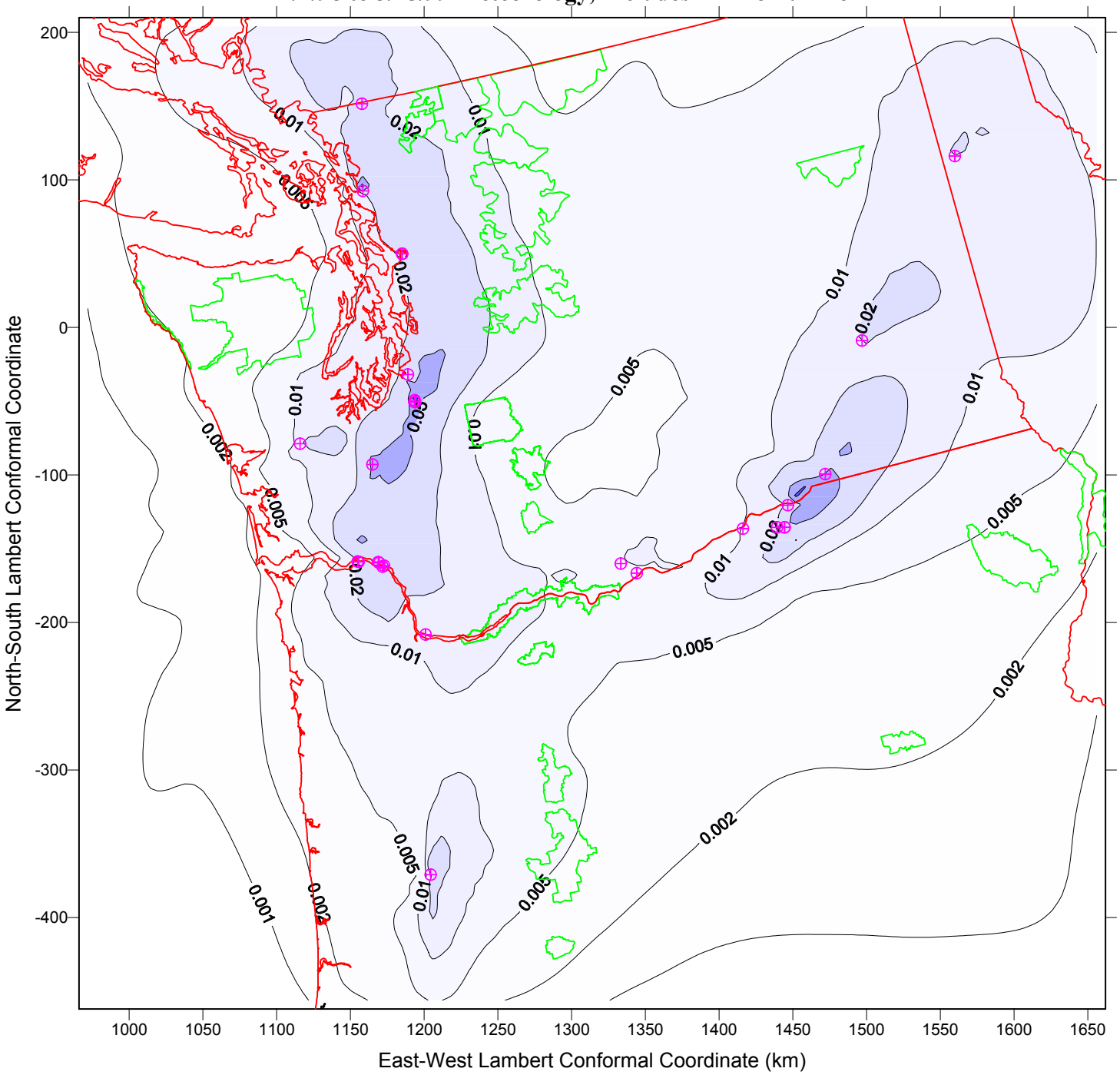
Note: Nitrogen deposition includes ammonium ion.

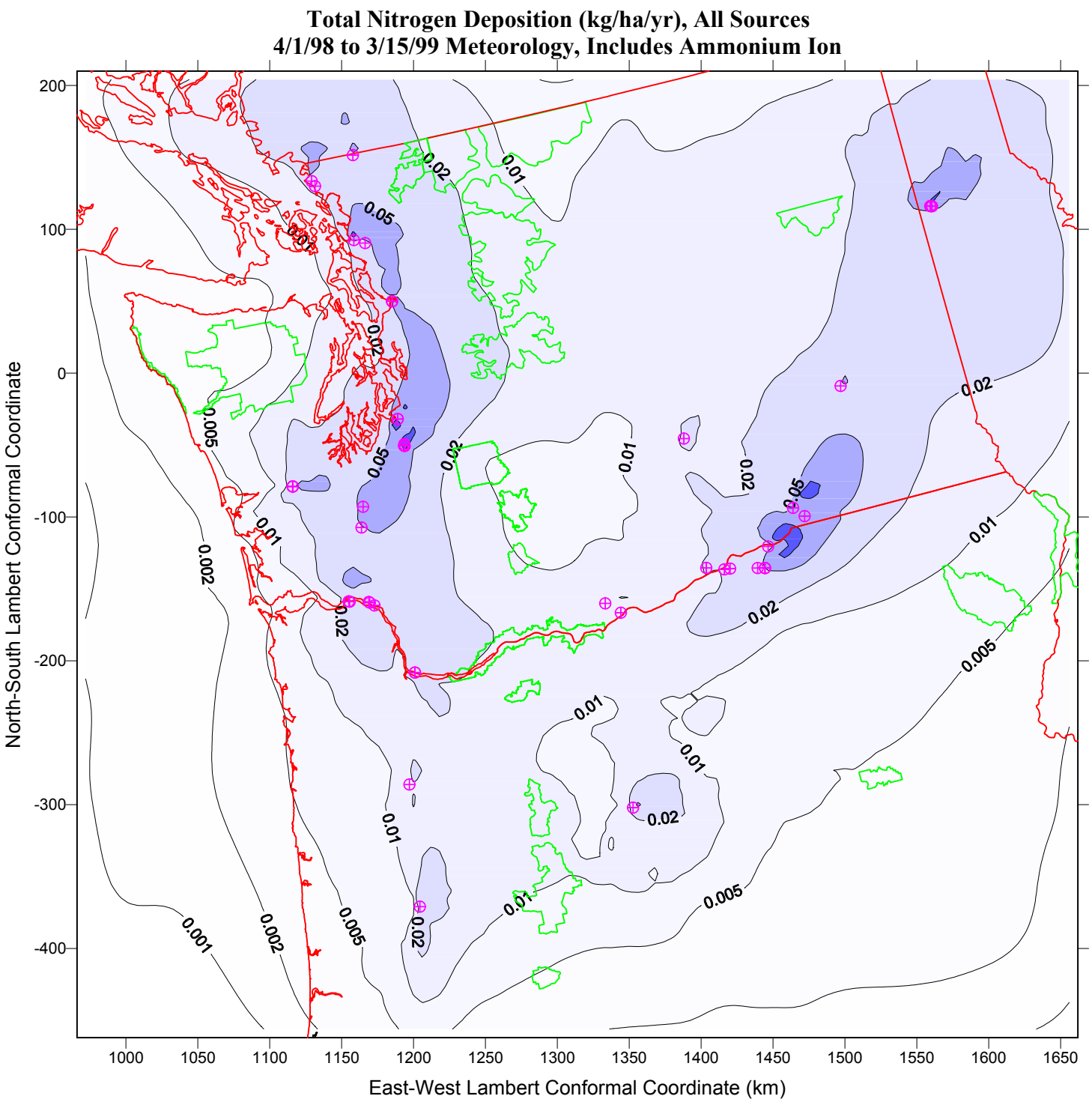
Maximum Annual Deposition (Wet + Dry) Flux
Includes All Sources

Area	Annual Sulfur Deposition (kg/ha/yr)				Annual Nitrogen Deposition (kg/ha/yr)			
	Background	Sources	Total	Change (%)	Background	Sources	Total	Change (%)
Diamond Peak Wilderness	4.000	0.003	4.003	0.064%	2.200	0.005	2.205	0.231%
Three Sisters Wilderness	5.600	0.006	5.606	0.101%	3.600	0.011	3.611	0.310%
Mt. Jefferson Wildnerness	4.000	0.006	4.006	0.148%	1.800	0.012	1.812	0.644%
Strawberry Mtn. Wilderness	1.400	0.003	1.403	0.194%	1.200	0.005	1.205	0.406%
Mt. Hood Wilderness	8.600	0.006	8.606	0.070%	5.400	0.013	5.413	0.240%
CRGNSA	12.000	0.009	12.009	0.075%	10.000	0.021	10.021	0.214%
Eagle Cap Wilderness	1.600	0.004	1.604	0.250%	1.600	0.010	1.610	0.595%
Hells Canyon Wilderness	1.400	0.004	1.404	0.256%	1.200	0.009	1.209	0.760%
Mt. Adams Wilderness	10.800	0.006	10.806	0.053%	9.000	0.011	9.011	0.126%
Goat Rocks Wilderness	11.800	0.006	11.806	0.049%	9.000	0.010	9.010	0.113%
Mt. Rainier National Park	3.100	0.011	3.111	0.354%	2.400	0.017	2.417	0.706%
Olympic National Park	5.600	0.007	5.607	0.119%	2.000	0.015	2.015	0.758%
Alpine Lakes Wilderness	7.200	0.024	7.224	0.327%	5.200	0.034	5.234	0.654%
Glacier Peak Wilderness	8.000	0.020	8.020	0.250%	5.800	0.023	5.823	0.401%
North Cascades National Park	3.500	0.029	3.529	0.812%	5.200	0.025	5.225	0.483%
Pasayten Wilderness	7.200	0.011	7.211	0.146%	5.200	0.012	5.212	0.222%
Mt. Baker Wilderness	No Data	0.052			No Data	0.040		
Spokane Indian Res.	No Data	0.008			No Data	0.019		
USFS Criteria			3.000				5.000	

Note: Nitrogen deposition includes ammonium ion.

Total Nitrogen Deposition (kg/ha/yr), Sources with Energization Date Before 1/04
4/1/98 to 3/15/99 Meteorology, Includes Ammonium Ion




Total Nitrogen Deposition (kg/ha/yr), All Sources
4/1/98 to 3/15/99 Meteorology, Includes Ammonium Ion
North-South Lambert Conformal Coordinate
East-West Lambert Conformal Coordinate (km)
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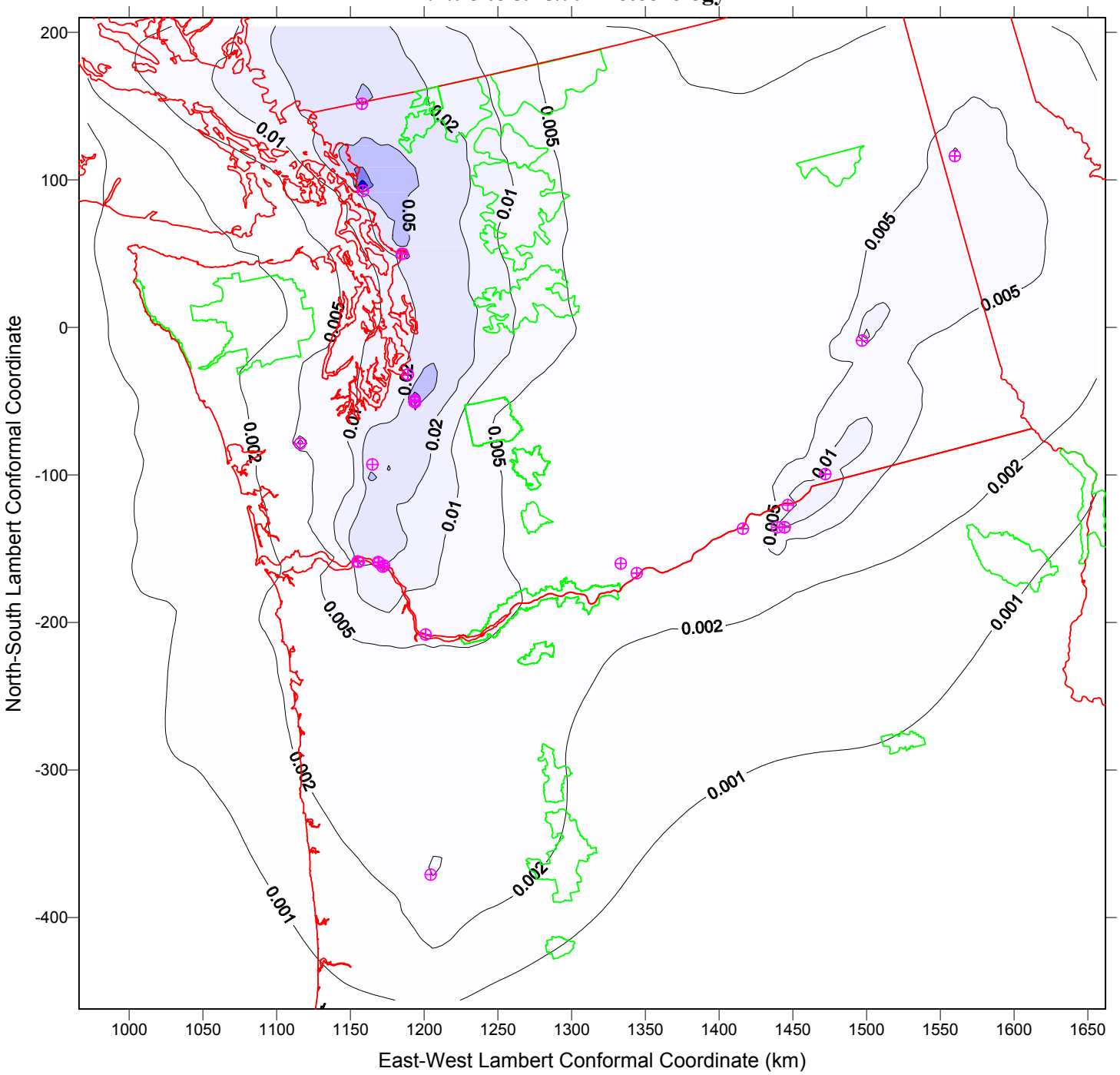
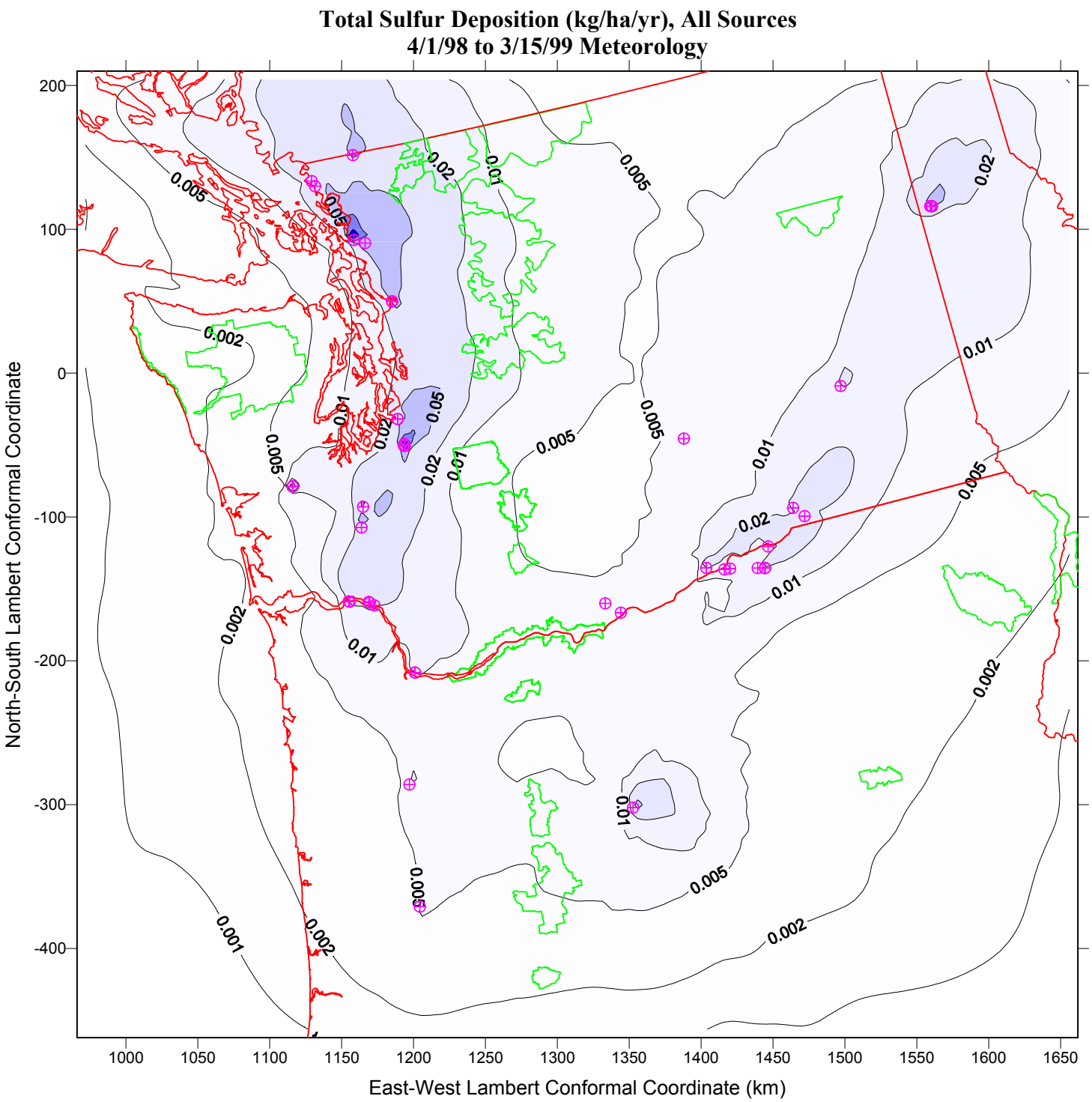
Total Sulfur Deposition (kg/ha/yr), Sources with Energization Date Before 1/04
4/1/98 to 3/15/99 Meteorology




Total Sulfur Deposition (kg/ha/yr), All Sources
4/1/98 to 3/15/99 Meteorology
North-South Lambert Conformal Coordinate
East-West Lambert Conformal Coordinate (km)
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0.005
0.01
0.02
0.05

Number of Days with Greater than 5% Change to Background Extinction
Includes Sources with Energization Dates Before Jan 2004

Area	Spring	Fall	Summer	Winter	Total
Diamond Peak Wilderness	0	0	0	0	0
Three Sisters Wilderness	1	1	0	0	2
Mt. Jefferson Wildnerness	0	0	0	1	1
Strawberry Mtn. Wilderness	0	0	0	0	0
Mt. Hood Wilderness	2	2	0	5	9
CRGNSA	3	9	9	5	26
Eagle Cap Wilderness	0	1	0	0	1
Hells Canyon Wilderness	0	0	0	0	0
Mt. Adams Wilderness	1	0	0	2	3
Goat Rocks Wilderness	0	1	0	0	1
Mt. Rainier National Park	13	4	4	1	22
Olympic National Park	1	7	0	8	16
Alpine Lakes Wilderness	19	6	5	10	40
Glacier Peak Wilderness	6	6	6	6	24
North Cascades National Park	3	3	2	5	13
Pasayten Wilderness	0	0	0	0	0
Mt. Baker Wilderness	12	9	11	11	43
Spokane Indian Res.	0	2	0	5	7

Background extinction based on aerosol concentrations on days with the best visibility. For the CRGNSA and Spokane Indian Reservation based on top 20 percent, for all other areas based on the average of the top 5 percent.

Number of Days with Greater than 5% Change to Background Extinction
Includes All Sources

Area	Spring	Fall	Summer	Winter	Total
Diamond Peak Wilderness	0	0	0	0	0
Three Sisters Wilderness	6	9	5	2	22
Mt. Jefferson Wildnerness	2	5	0	3	10
Strawberry Mtn. Wilderness	0	0	0	2	2
Mt. Hood Wilderness	5	17	3	6	31
CRGNSA	10	19	17	11	57
Eagle Cap Wilderness	1	2	0	3	6
Hells Canyon Wilderness	0	0	0	0	0
Mt. Adams Wilderness	1	8	0	7	16
Goat Rocks Wilderness	2	6	0	2	10
Mt. Rainier National Park	18	11	9	8	46
Olympic National Park	8	14	1	16	39
Alpine Lakes Wilderness	28	19	16	22	85
Glacier Peak Wilderness	12	12	12	12	48
North Cascades National Park	6	6	6	7	25
Pasayten Wilderness	1	2	0	4	7
Mt. Baker Wilderness	18	20	18	17	73
Spokane Indian Res.	0	9	2	13	24

Background extinction based on aerosol concentrations on days with the best visibility. For the CRGNSA and Spokane Indian Reservation based on top 20 percent, for all other areas based on the average of the top 5 percent.

Number of Days with Greater than 10% Change to Background Extinction
Includes Sources with Energization Dates Before Jan 2004

Area	Spring	Fall	Summer	Winter	Total
Diamond Peak Wilderness	0	0	0	0	0
Three Sisters Wilderness	0	0	0	0	0
Mt. Jefferson Wildnerness	0	0	0	0	0
Strawberry Mtn. Wilderness	0	0	0	0	0
Mt. Hood Wilderness	0	0	0	1	1
CRGNSA	0	0	0	1	1
Eagle Cap Wilderness	0	0	0	0	0
Hells Canyon Wilderness	0	0	0	0	0
Mt. Adams Wilderness	0	0	0	0	0
Goat Rocks Wilderness	0	0	0	0	0
Mt. Rainier National Park	6	1	0	0	7
Olympic National Park	0	1	0	1	2
Alpine Lakes Wilderness	4	0	0	3	7
Glacier Peak Wilderness	0	0	0	0	0
North Cascades National Park	0	1	0	0	1
Pasayten Wilderness	0	0	0	0	0
Mt. Baker Wilderness	2	2	2	1	7
Spokane Indian Res.	0	1	0	0	1

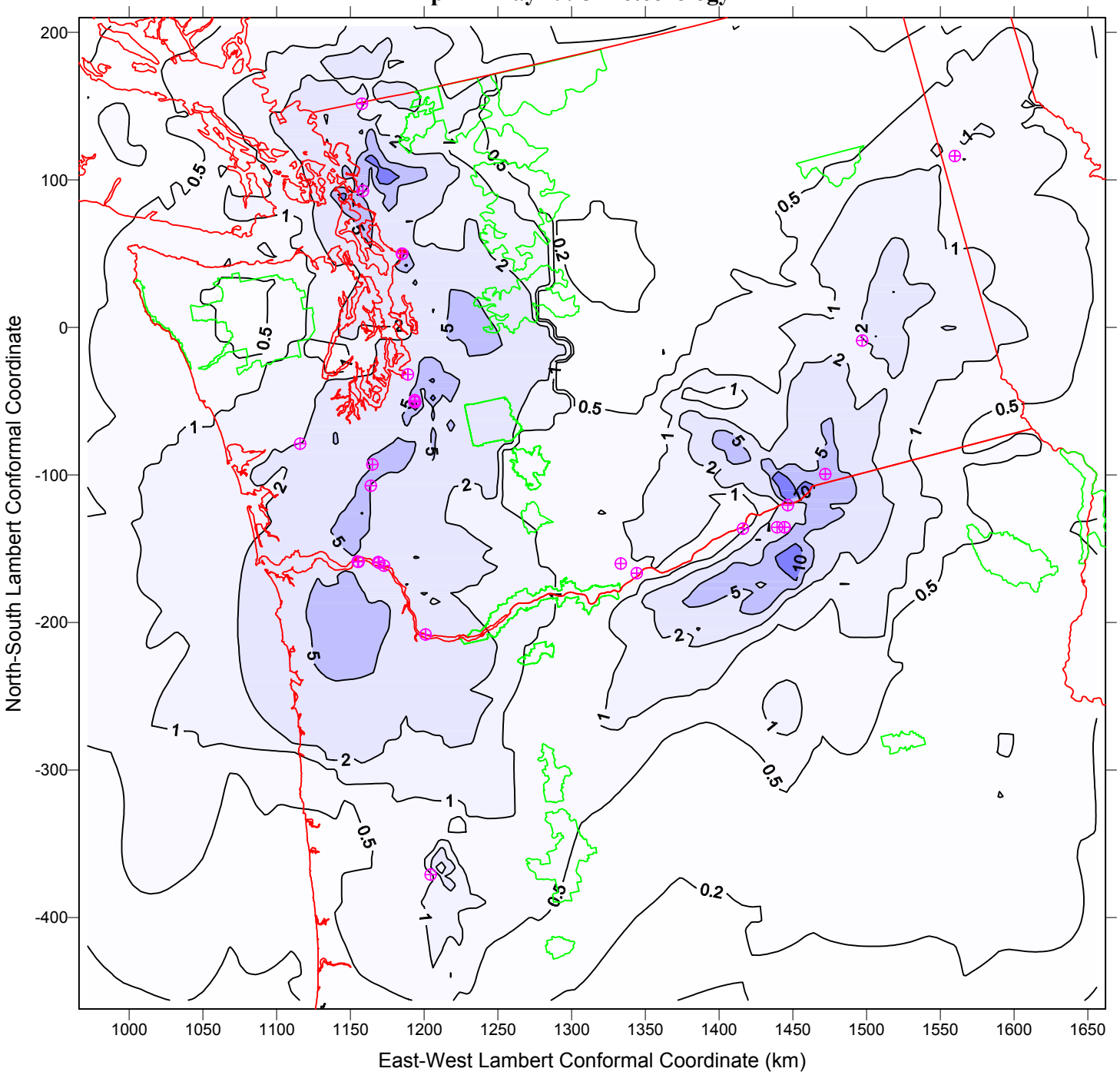
Background extinction based on aerosol concentrations on days with the best visibility. For the CRGNSA and Spokane Indian Reservation based on top 20 percent, for all other areas based on the average of the top 5 percent.

Number of Days with Greater than 10% Change to Background Extinction
Includes All Sources

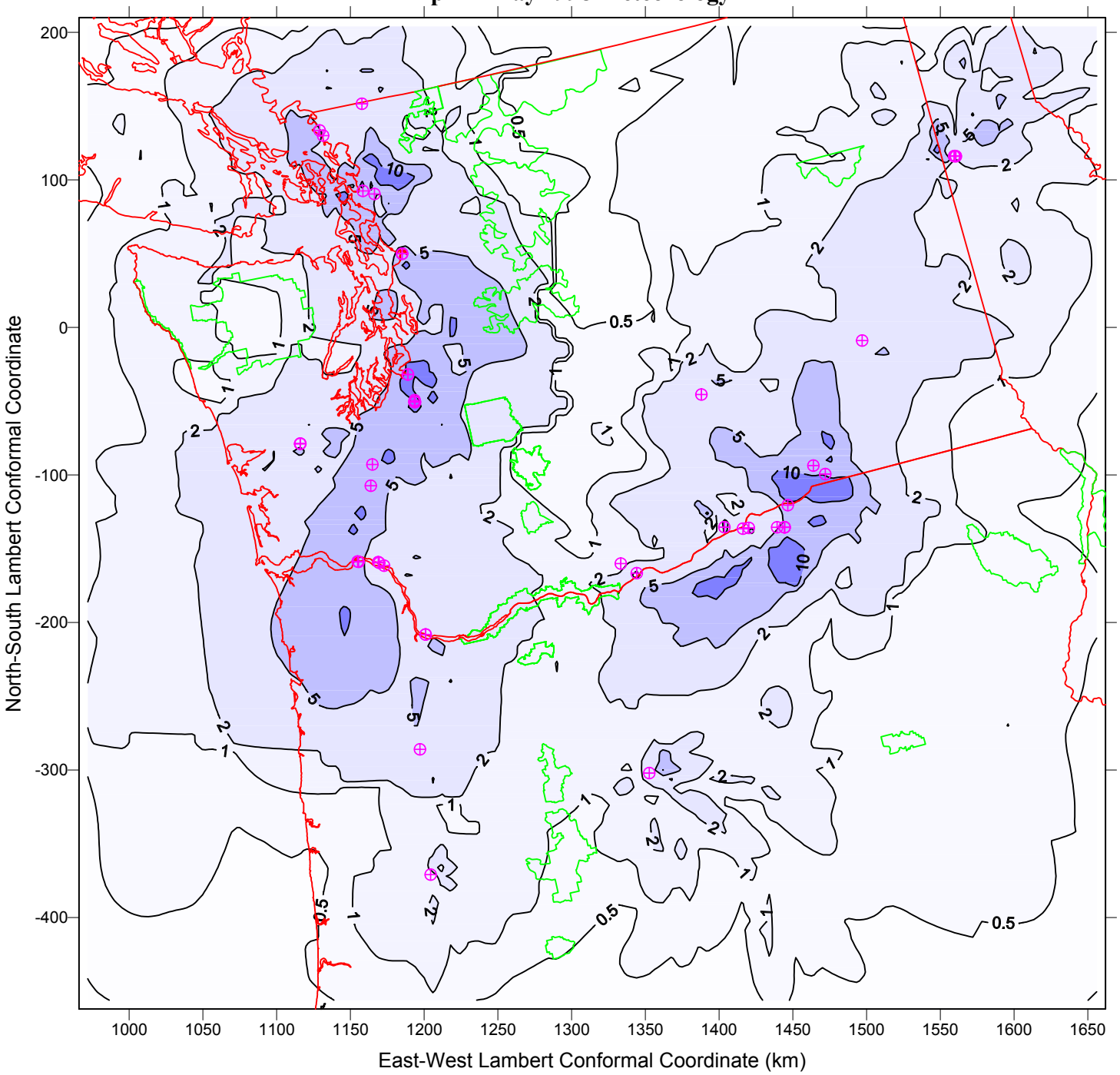
Area	Spring	Fall	Summer	Winter	Total
Diamond Peak Wilderness	0	0	0	0	0
Three Sisters Wilderness	0	2	0	1	3
Mt. Jefferson Wildnerness	0	0	0	2	2
Strawberry Mtn. Wilderness	0	0	0	0	0
Mt. Hood Wilderness	0	2	0	5	7
CRGNSA	0	9	1	6	16
Eagle Cap Wilderness	0	0	0	0	0
Hells Canyon Wilderness	0	0	0	0	0
Mt. Adams Wilderness	0	1	0	2	3
Goat Rocks Wilderness	0	0	0	0	0
Mt. Rainier National Park	9	2	1	0	12
Olympic National Park	0	6	0	5	11
Alpine Lakes Wilderness	12	2	0	4	18
Glacier Peak Wilderness	1	1	1	1	4
North Cascades National Park	0	1	0	1	2
Pasayten Wilderness	0	0	0	0	0
Mt. Baker Wilderness	5	5	5	5	20
Spokane Indian Res.	0	4	0	2	6

Background extinction based on aerosol concentrations on days with the best visibility. For the CRGNSA and Spokane Indian Reservation based on top 20 percent, for all other areas based on the average of the top 5 percent.

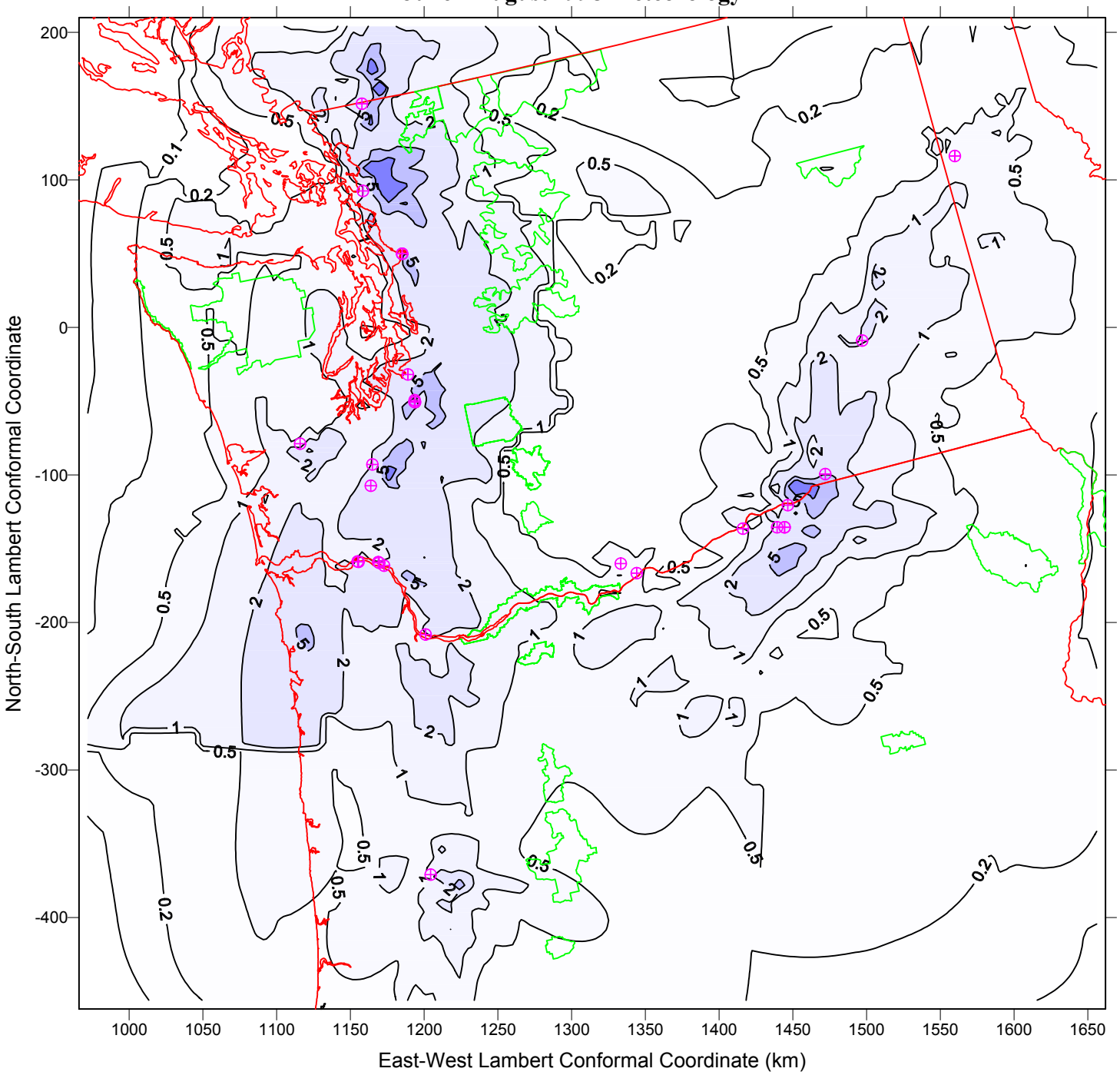
24-hr Max Bext (1/Mm), Sources with Energization Date Before 1/04
April - May 1998 Meteorology



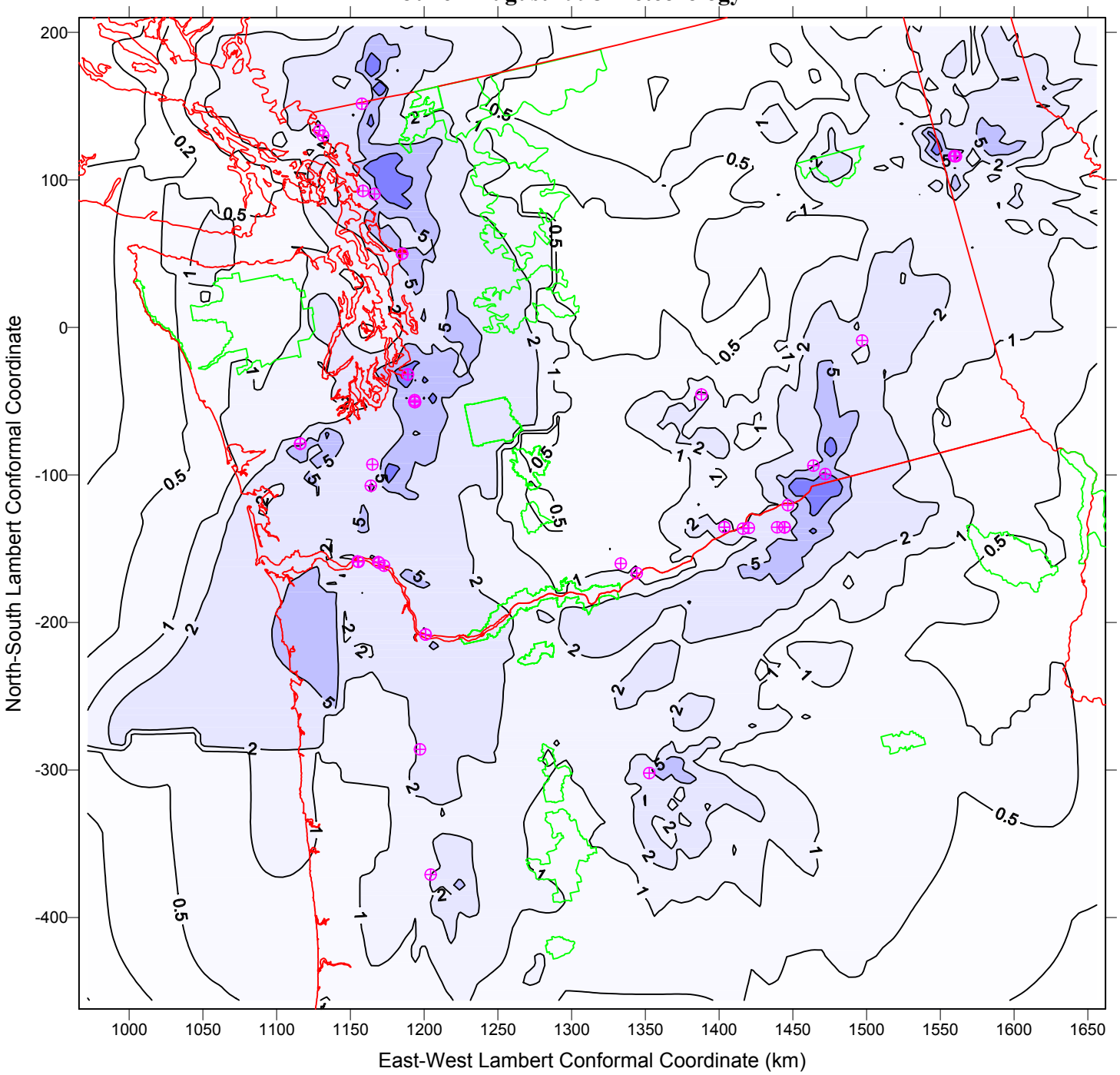
24-hr Max Bext (1/Mm), All Sources
April - May 1998 Meteorology



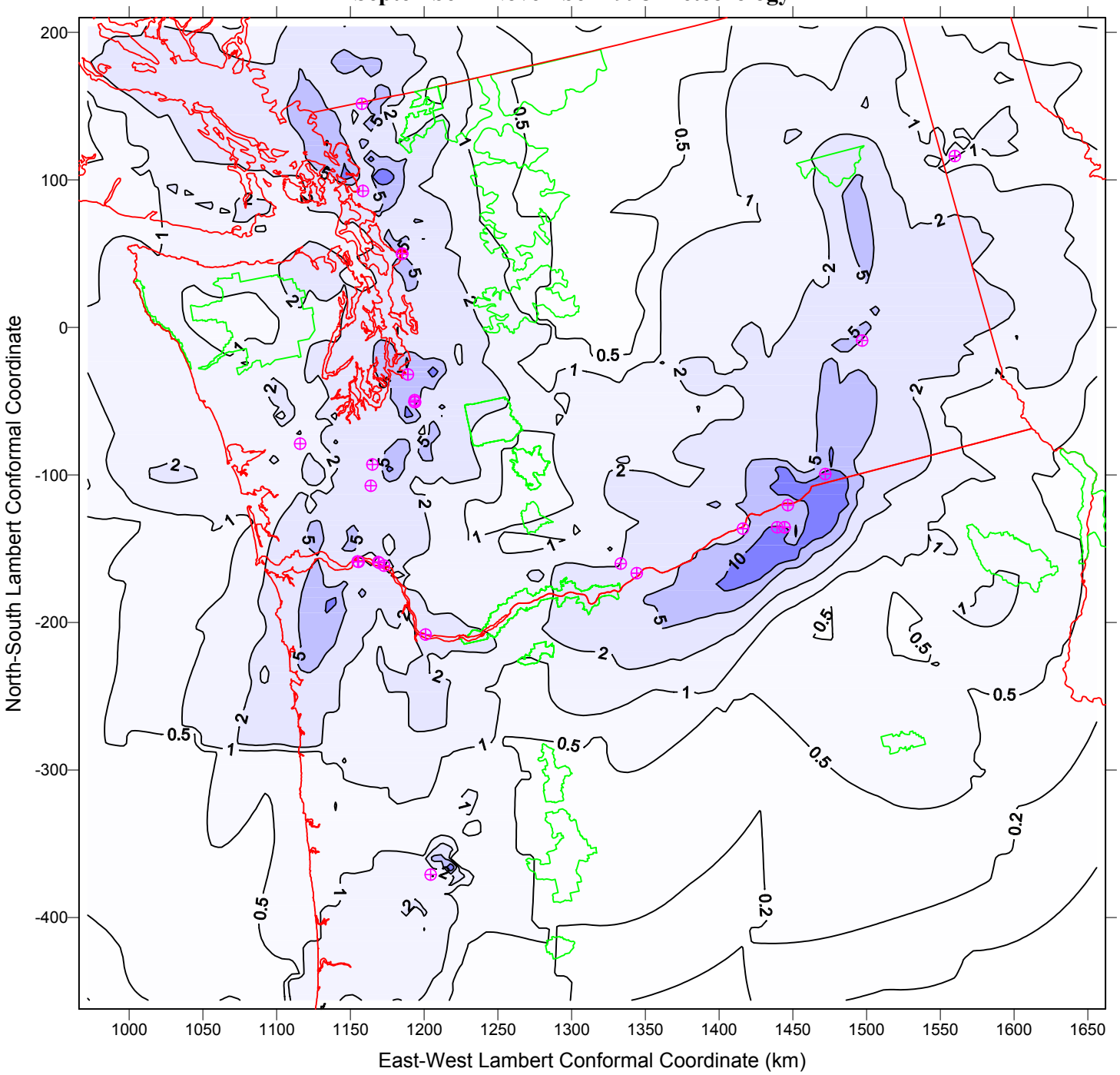
24-hr Max Bext (1/Mm), Sources with Energization Date Before 1/04
June - August 1998 Meteorology

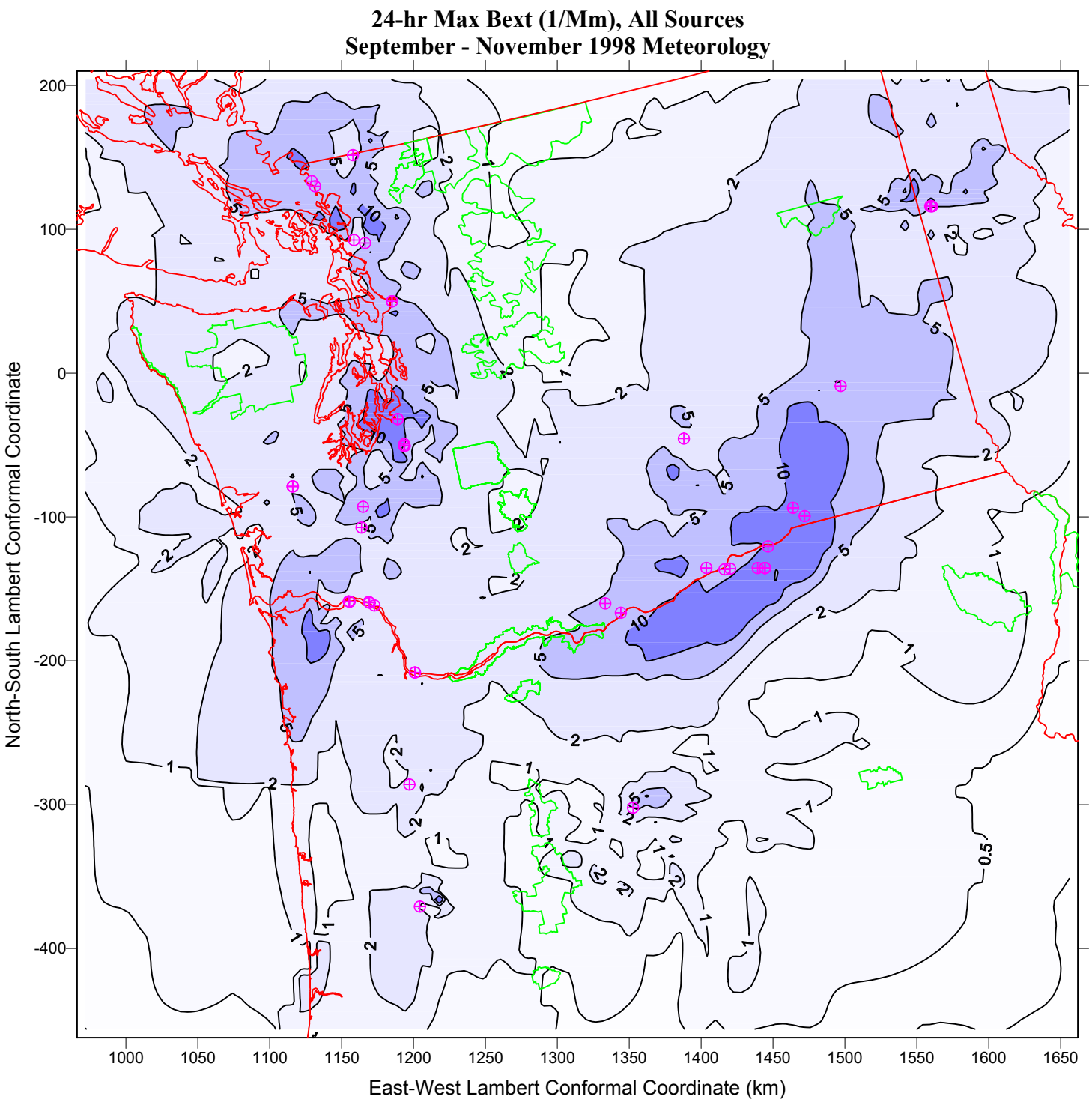


24-hr Max Bext (1/Mm), All Sources
June - August 1998 Meteorology



24-hr Max Bext (1/Mm), Sources with Energization Date Before 1/04
September - November 1998 Meteorology




24-hr Max Bext (1/Mm), All Sources
September - November 1998 Meteorology
North-South Lambert Conformal Coordinate
East-West Lambert Conformal Coordinate (km)
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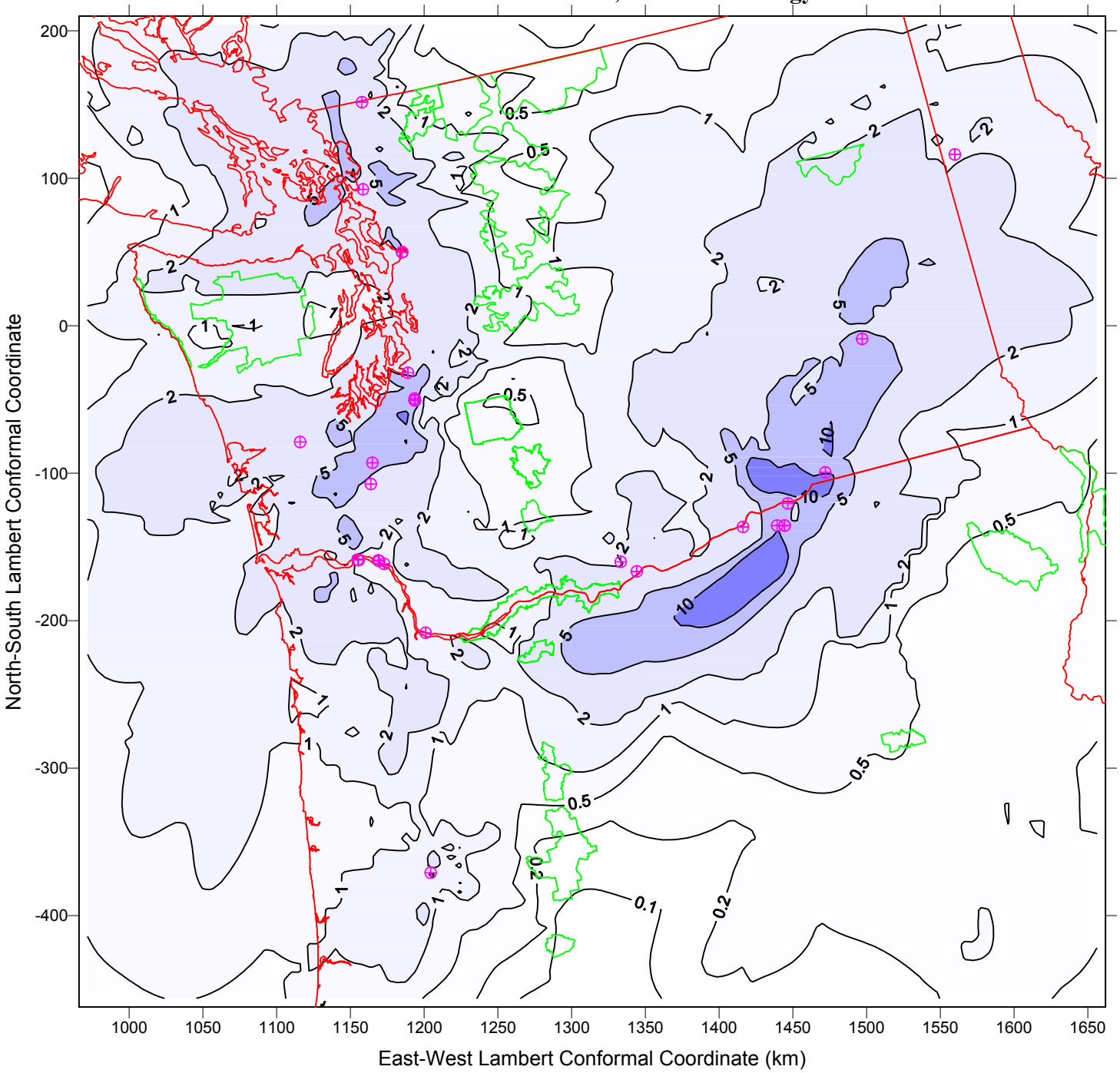
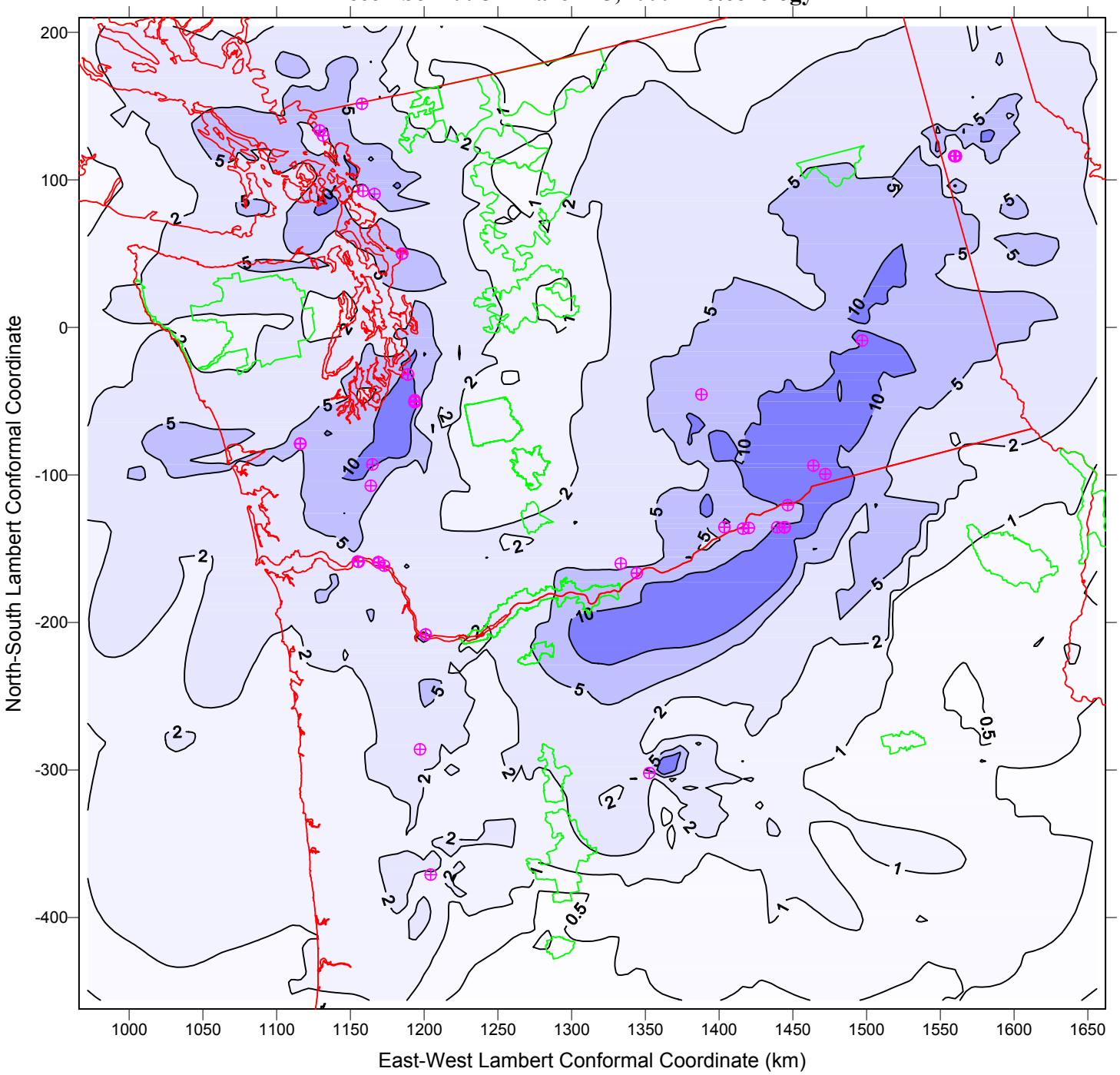
24-hr Max Bext (1/Mm), Sources with Energization Date Before 1/04
December 1998 - March 15, 1999 Meteorology



24-hr Max Bext (1/Mm), All Sources
December 1998 - March 15, 1999 Meteorology



Regional Air Quality Impacts Study
Carbon Dioxide Emissions from Proposed Power Plants
(08/01/2001)

Source Name	State	Ener. Date	Net Output (MW) Ann Avg	CO2 Annual (tons)
AES COLUMBIA				
Columbia River Project	WA	May-02	220	1,201,718
AVISTA				
Coyote Springs 2	OR	Jun-02	280	920,939
Mint Farm Generation Project I	WA	Jul-03	248	1,001,835
Columbia Peaking Generation Project	WA	Dec-01	192	775,614
BP				
Cherry Point	WA	Jan-04	750	3,029,744
CALPINE				
Ferndale	WA	Jun-05	600	2,423,795
Fredrickson	WA	May-02	350	1,413,881
Hermiston	OR	Sep-02	546	2,205,654
Hermiston II	OR	Jun-04	600	2,423,795
Hermiston Peaker	OR	Dec-01	200	807,932
Mount Vernon	WA	Jun-05	600	2,423,795
Salem (Bethel PGE)	OR	Jun-04	600	2,423,795
Vancouver a (Alcoa)	WA	Nov-01	100	403,966
Vancouver b (Alcoa)	WA	Jun-05	600	2,423,795
Goldendale Energy Project	WA	Jul-02	248	1,001,835
COGENTRIX				
Rathdrum Power, LLC	ID	Aug-01	270	1,090,708
Mercer Ranch Generation Project	WA	Oct-04	800	3,231,727
Grizzly Power	OR	Jul-04	874	3,530,662
Northern Idaho Power	ID	Dec-04	810	3,272,124
CONFEDERATED TRIBES				
Umatilla Tribal Generation Project	OR	Jul-03	1,000	4,814,671
DUKE				
Pierce County Project	WA	Jan-03	84	90,084
Satsop CT Project - Phase I	WA	Jan-03	562	2,042,963
Satsop CT Project - Phase II	WA	Oct-04	638	2,392,847
Satsop CT Project - Phase III	WA	Oct-04	638	2,392,847
ENRON				
Longview Energy	WA	Jul-03	290	1,126,567
CO2 from burning #2 fuel oil	WA	Jul-03	----------	265,898
FPL/NORTHWEST POWER				
Everett Delta I	WA	Sep-02	248	973,674
Everett Delta II	WA	Sep-02	248	973,674
FRONTIER ENERGY				
Coburg Power	OR	Aug-03	570	1,943,368
CO2 from burning #2 fuel oil	OR	Aug-03	----------	1,458,686
GRANT County LLC				
Mattawa (Grant Co)	WA	Jun-05	1,300	5,251,556

Regional Air Quality Impacts Study
Carbon Dioxide Emissions from Proposed Power Plants
(08/01/2001)

Source Name	State	Ener. Date	Net Output (MW) Ann Avg	CO2 Annual (tons)
Kootenai Generation				
Kootenai Power (Rathdrum)	ID	Jun-05	1,240	5,009,177
NESCO				
Sumas Energy 2	WA	Jan-02	660	2,417,744
NEWPORT GENERATION				
Wallula Power Project	WA	Jul-04	1,300	5,251,556
NORTHWEST POWER ENT.				
Starbuck	WA	Oct-03	1,180	3,769,997
PG&E				
Umatilla Generating Project	OR	Nov-03	580	2,077,749
Morrow Generating Project	OR	Jan-05	580	2,077,749
PORTLAND GENERAL ELECTRIC				
Coyote Springs I only	OR	On-line	250	1,000,783
CO2 from burning #2 fuel oil	OR	On-line	----------	82,520
Port Westward	OR	Dec-03	650	2,480,718
PUGET SOUND ENERGY				
Fredonia Facility	WA	Jul-01	No Data	
SOUTHWESTERN POWER GROUP				
Port of Tacoma Generation Project Phase I Peaking Project	WA	Jun-02	170	158,625
Port of Tacoma Phase II (5 units)	WA	Jun-04	No Data	793,125
SUMMIT				
Goldendale (The Cliffs)	WA	Feb-02	225	977,550
Summit/Westward (Clatskanie)	OR	Nov-03	520	1,857,120
TRACTABEL				
Chehalis Generating Facility	WA	Nov-03	520	1,725,240
CO2 from burning #2 fuel oil	WA	Nov-03		208,050
TRANSALTA				
TransAlta Centralia Generation LLC Big Hanaford Project	WA	Jun-01	174	702,901
WESTCOAST				
Frederickson Power	WA	May-02	249	1,005,875
Frederickson Power II	WA	Jan-04	249	917,610
Total				92,248,239